QUANTIFICATION OF SMOKE PRODUCED IN FIRES

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To my wife

ABSTRACT

It is necessary to provide reasonable life protection against hazards of fire. The smoke hazard is identified as an important factor. In this study three of the existing test methods are investigated to establish advantages and disadvantages of each and to identify correlation if they exist. In addition, a series of experiments has been carried out on a small scale room-corridor assembly under different conditions.

For two of the laboratory tests (EU and Arapahoe), fifteen materials have been tested while for NBS test only eleven materials were studied. The smoke yield was expressed as smoke potential (D_o), which relates to the mass of material burnt rather than its surface area. The results show that smoke potential is a better method of expressing the amount of smoke from a given material. There is a good correlation between the NBS (flaming) test and the Arapahoe, and reasonable agreement between EU test and NBS test under non-flaming conditions. Generally speaking, the cellulosic materials have a lower D_o than the plastics. Arapahoe test is less sensitive to the variation of the test conditions than EU test.

In the small scale room corridor assembly, the yield of cold smoke measured as it accumulates in a large volume (D_o(static)) is higher than the hot smoke measured as it flows from the end of the corridor (D_o(dynamic)). The difference between the two depends on ventilation, length of corridor (test rig) and type of fuel bed. Higher smoke yields were found in these experiments than in standardized laboratory tests. In this project, it has been found that there are still big differences between the results of the smoke tests. The relevance of these tests to real fire is not clear. However, the use of small scale room corridor experiments is necessary as a preparatory stage to carrying out a limited series of full scale fire to obtain more information on real fire behaviour.

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ABBREVIATIONS

A	Area (m^2) (sample or ventilation opening)
Af	Exposed surface area of the combustible material
ABS	Acrylonitrile-Butadiene-Styrene
B	Fuel bed enclosed in fire box
C_S	Mass concentration of particles (gm/cm^3)
c	Thermal capacity
D/metre	Optical density (ob = db/m)
D'/metre	Optical density (bel/m)
D_O	Standard optical density ($ob.m^3/g\dot{m}$)
D_S	Specific optical density (bel)
EU	Edinburgh University
F	Flaming
FB	Free burning
FIB	Fibreboard
g	Acceleration due to gravity
H	Height (ventilation opening, m)
I	Light intensity falling on the photocell in the presence of smoke
I_O	Light intensity falling on the photocell in the absence of smoke
K	Thermal conductivity
L	Light path length (m)
$\dot{m}$	Rate of burning
M	Airborne mass loss of the specimen measured in grams in the NBS chamber
Ma	Airborne mass loss in Arapahoe chamber
Mp	Smoke particulate mass determined in the Arapahoe chamber
NBS	National Bureau of Standard Chamber test

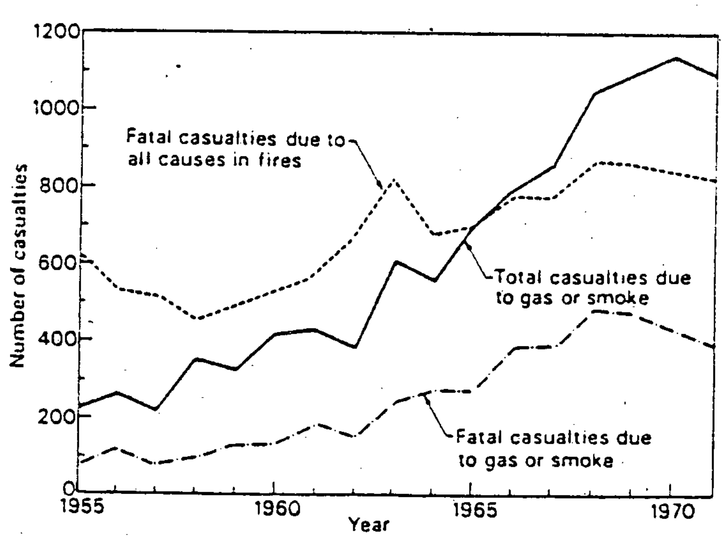
NF	Non-flaming
PMMA	Polymethylmethacrylate
(POD)	Particulate optical density (cm^2/gm)
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinylchloride
r	The particulate radius (microns)
T	Temperature
T_1	Ambient temperature
T_2	Gases temperature
T_3	Box temperature
Tf	Final temperature
Ti	Initial temperature
Tp	Percentage transmittance (light)
Ts	Surface temperature
t_a	Time between maximum obscuration and the end of the 20 minutes
t_b	Burning time
t_f	Airflow time
t_m	Time to the maximum obscuration
V_s	Volume of smoke
W_L	Weight loss
X_s	The efficiency factor for light scattering
α	Thermal diffusivity
ρ	Density (kg/m^3)
σ	Attenuation coefficient (m^{-1})

CHAPTER I

Introduction

The Principal hazard to life safety during a fire in a building has been identified as the smoke produced. This is verified by the latest available fire casuality statistics for the UK. Over fifty-six per cent of fire fatalities were attributed to smoke (UK Statistics, 1982). Similar statistics have been found in the United States of America (NFPA, 1981). A Statistics of Casualties by Bowes (1974) is given in Figure 1.1. The number of fatalities which has been attributed to smoke has risen significantly over the period 1955 to 1972.

FIGURE 1.1



Casualties "overcome by gas or smoke" in fires.

It is usually considered that the initial threat arises from the early loss of visibility which delays escape from the building by the occupants and hinders rescue attempts. Prolonged exposure to toxic and heated gases may subsequently result from this delay. For this reason, standard tests have been developed to measure the amount of smoke generated from materials in fire.

Gross *et al.* (1966) defined smoke as "the gaseous products of burning organic materials in which small solid and liquid particles are also dispersed". Gaskill (1973) defined it as "the airborne products evolved when a material decomposes by pyrolysis on combustion", while Maries (1978) defined smoke as "the mixture of particulate and gaseous products of combustion with the surrounding atmosphere". The quantity and the nature of these particulates in the smoke determine the major hazard in fire. Rasbash and Drysdale (1982) have pointed out that the particulate smoke is a product of incomplete combustion and is generated in both flaming and non-flaming combustion, although the nature of the particles and their modes of formation are very different. Smoke from non-flaming combustion is very similar to that obtained when any carbon-based material is heated to a temperature at which there is chemical decomposition and evolution of volatiles. Smoke from flaming combustion is quite different in nature and, apart from some aerosol mist that may escape from passing through the flame, consists entirely of solid particles.

The potential of combustible materials to yield particulate smoke has been identified as an important "fire property". Tests have been developed which are intended to measure this potential, but unfortunately the amount of smoke generated from a burning material depends not only on the nature of the material itself, but also on the circumstances of burning. For example, the level of radiant heat flux, the rate of burning, ventilation and the distribution of combustible material. These tests comprise more than 15 standards throughout the world, almost all assessing the yield of particulate smoke from burning materials by one of the following methods (Drysdale, 1982).

1. Filtering the smoke and determining the weight of particulate matter (gravimetric method).
2. Collecting the smoke in a known volume and determining its optical density, which is related to obscuration and visibility.
3. Measuring the optical density of the smoke as it is emitted from the combustion chamber or fire compartment, and integrating it over time to obtain a measure of the total smoke yield.

The smoke density is commonly measured as an optical density per metre path length (D), by determining the attenuation of a light beam passing through a layer of smoke and falling onto a photo electric cell. It is defined as:

$$D = -\frac{10}{L} \log_{10} \frac{I}{I_0} \quad \text{decibel per metre (db/m)}$$

where I and I_0 are the intensities of light falling on the photo cell in the presence and absence of smoke, respectively (see paragraph 2.1).

Substantial efforts have been, and are being made to develop methods of determining the smoke production potential of combustible materials which will be meaningful in the context of fire safety. Most effort has gone towards producing an apparatus which creates a standard, reproducible fire environment into which the material is placed. However, all of these involve burning the material under a set of precisely defined conditions which are intended to be representative of a typical fire. With a few exceptions, the results are expressed in terms of the optical density, and may be used to place in order different materials according to their propensity to produce smoke.

The most widely used test is ASTM E662 (ASTM, 1979), often referred to as the "NBS test". While many variations have been proposed (e.g. Seader and Chein, 1974; Routley, 1980; Edgerley and Pettett, 1980) both in the apparatus itself and the procedure, the basic method remains the same. A small sample of material in a vertical configuration is exposed to a radiant heat flux in the presence or absence of flame, and the opacity of the smoke produced is measured as it is collected in a known volume (0.51 m^3). The smoke yield can be expressed either in terms of the surface area exposed to the radiant heat flux (ASTM, 1979), or in terms of the mass loss during the test (Seader *et al.*, 1974: Edgerley *et al.*, 1978). In adopting such a test, it is assumed that smoke yield is a property of the material burning and that the conditions of burning are of secondary importance. This is known to be incorrect. For example, a change in the radiant heat flux may not only change the amount of smoke produced, but it may alter the ranking order of a series of combustible materials (Edgerley *et al.*, 1980; Calcraft *et al.*, 1975).

Any acceptable smoke test must exhibit good reproducibility and interlaboratory repeatability [Sparkes *et al.*, 1977, defined reproducibility as "the mean smoke value required to discriminate (with good confidence) between materials run in different apparatus at different laboratory locations", while the repeatability as "the percentage of difference within laboratory with one operator required to establish (with good confidence) that materials are distinguishable from one another in average smoke value".] However, these points have received too much attention and the question has not been considered sufficiently. Although some attempts have been made to investigate this matter, these have been of limited success (Christian *et al.*, 1971; Rasbash *et al.*, 1979/80;

Woolley *et al*., 1979/80). One of the difficulties is that to measure smoke production from a full scale fire, the volume of smoke is too great to be collected. Instead, the optical density of the smoke is monitored continuously as it flows from the test rig, e.g. at the end of the corridor (Woolley *et al*., 1979/80). The total amount of smoke generated is then obtained by integrating over the duration of the test. Smoke measured in this way can be several hundred degrees higher than the smoke which accumulates in the NBS chamber. If a fire occurs within a building, the smoke which invades escape routes is relatively cool and hinders escape by reducing visibility. Other products of combustion may make the situation worse by causing irritation of the eyes and respiratory tract and impeding movement still further, but these effects are difficult to quantify. Taking reduced visibility as the primary hazard, it would seem that the yield of "cold smoke" is more relevant to the problem of life safety. For this reason it may be argued that tests involving "static measurement" (e.g. ASTM E662) should be used for material selection, although the question of whether the results from such small scale tests are relevant to the full-scale fire situation has still to be answered.

The objectives of the work reported here are:

1. To compare some of the existing test methods to establish the advantages and disadvantages of each, and to identify correlations if they exist. The following laboratory tests have been studied.

   (a) The NBS smoke chamber test (ASTM, 1979).

   (b) The Edinburgh Chamber test (Phillips, 1976).

   (c) The Arapahoe chamber test (ASTM, 1982).

2. To carry out a series of experiments on a small scale to investigate the relationship between smoke production from materials burning in an enclosure and certain experimental variables, namely ventilation, nature of the fuel and the geometry of the experimental rig. In this way the range of conditions under which the small-scale laboratory smoke tests are relevant to smoke production for "real" fire was investigated (three materials tested: wood, PMMA and PP).[1]

3. To look for correlations between smoke yield and the various experimental parameters which will make it possible to examine simple models for smoke production. Results on this small scale may provide guidance on the need for further investigation on a large scale.

The three small-scale laboratory tests were thoroughly investigated and particular reference made to the variation of test parameters in order to determine the sensitivity of the results to such variation. Fifteen materials were tested.

The compartment tests were carried out at the Scottish Fire Service Training School in Gullane, East Lothian. The Edinburgh chamber test and the Arapahoe chamber test were carried out at the laboratory of the Fire Engineering Department, Edinburgh University, while the NBS chamber test was carried out at Yarsley Technical Centre, Redhill, Surrey.

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[1] PMMA = Polymethylmethacrylate
PP = Polypropylene

CHAPTER II

Smoke, Test Methods and Conditions

For convenience, the term "smoke" is taken here to mean the air-borne particle component in the products of fire. Combustible materials may undergo either flaming or non-flaming combustion. In flaming, the smoke consists mainly of solid particles which are formed in the gas phase as a result of incomplete combustion. Smoke from non-flaming combustion is similar to that obtained when any carbon-based material is heated to a temperature at which there is chemical degradation and evolution of volatiles (Drysdale, 1982).

Bankston *et al*. (1981) have provided an illustration of a burning surface (Figure 2.1a). They differentiate three regions in the solid phase, namely virgin material, the thermal degradation region and the char region. The formation and thickness of these regions depend on the material's nature. Many materials (e.g. PMMA) do not have a char region. Cullis and Hirschler (1981) present a useful summary for thermal decomposition of polymers of different composition, shown in Table 2.1 (see Section 2.3.1.2a).

The region between the solid phase and the flame is characterised by a steep temperature rise. The initiation of particulate formation happens in this zone where oxygen concentrations are very low. Kent *et al*. (1981) have shown that soot particles are formed on the fuel side of diffusion flame.

Woolley and Fardell (1977) considered the routes which lead to product formation in a fire situation. The burning product groups I and II (in Figure 2.1b) are released from the thermal decomposition zone (Figure 2.1a) as a result of oxidative decomposition and pryolysis, respectively. These may escape without further change (combustion product group VII), or can undergo further oxidative decomposition and pyrolysis to give product groups III and IV. Product groups IV

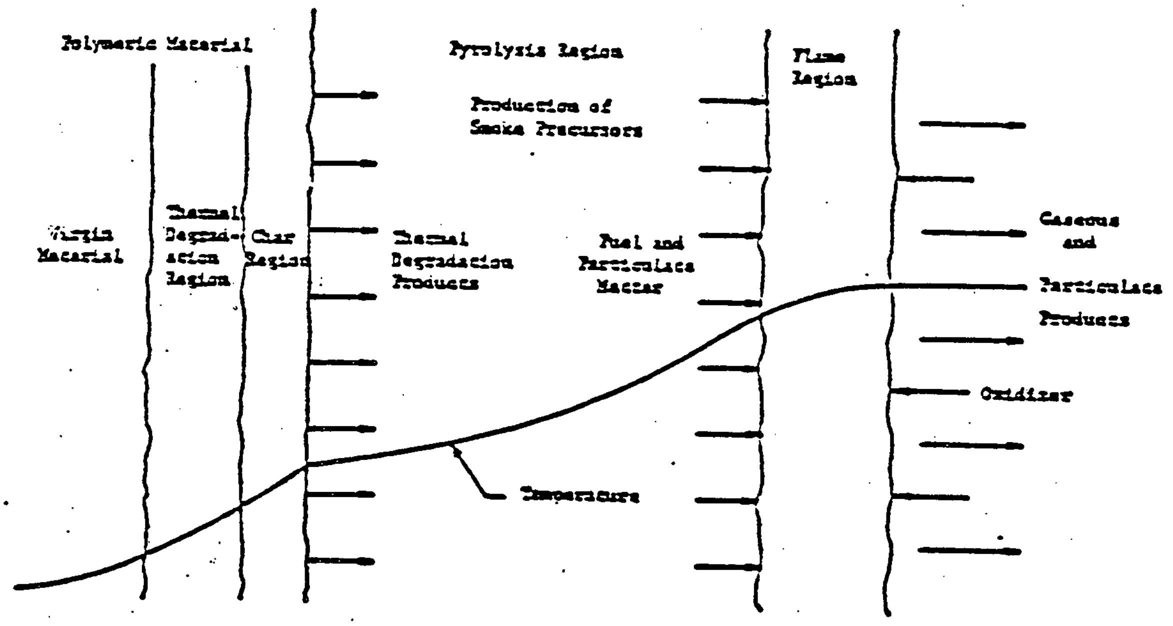


FIGURE 2.1a: Illustration of a polymer flame (Bankston *et al.*, 1981).

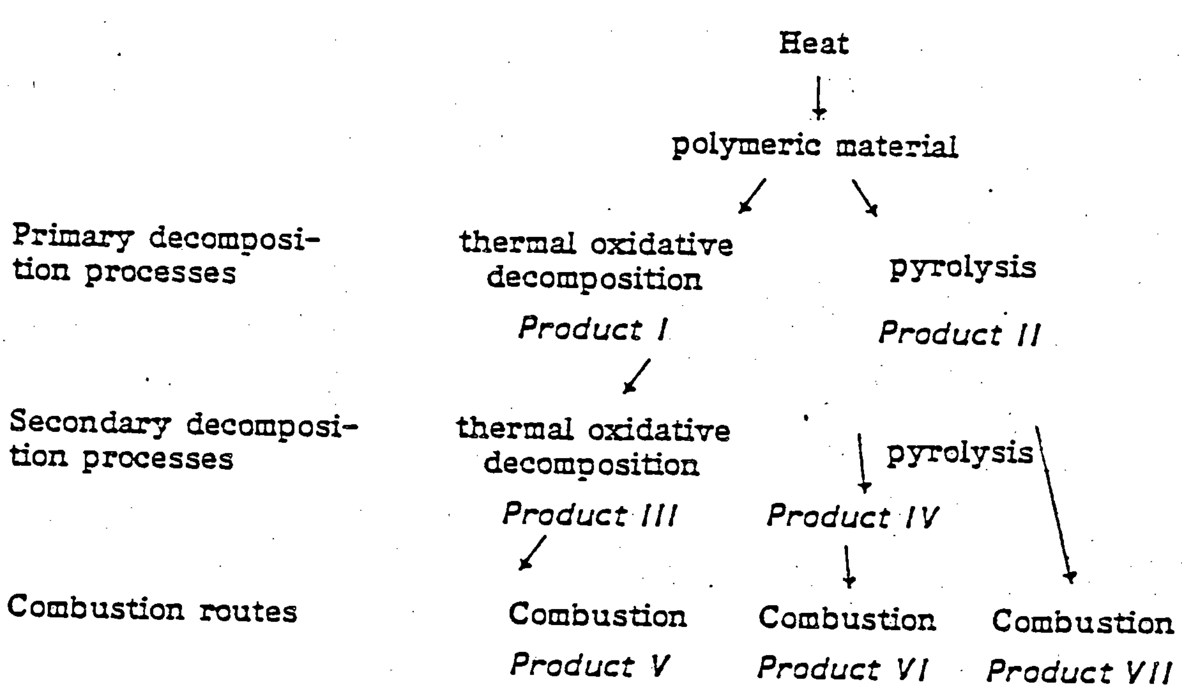


FIGURE 2.1b: Product formation routes in fires (Woolley *et al.*, 1977).

TABLE 2.1: General mechanism of thermal decomposition of organic polymers (Cullis *et al.*, 1981).

Mechanism	Polymer (example)	Products
Random-chain scission	Polyethene, polypropylene	Alkanes, alkenes, very little monomer.
	Polystyrene [1]	Styrene monomer, dimer and trimer.
	General	Monomers and oligomers.
End chain scission	PMMA	
	Polymethacrylonitrile	
	Poly(α-methyl styrene)	
	Polytetrafluoroethylene	90-100% monomer.
	Polyformaldehyde	
	General	Monomer.
Chain stripping	Poly(vinyl chloride)	Hydrogen chloride, aromatic hydrocarbon and char.
	Poly(vinylidene chloride)	Hydrogen chloride, and char.
	Poly(vinylalcohol)	Water and char.
	General	Small molecules and char.
Cross-linking	Polyacrylonitrile	Char.
	Poly(oxy-m-xylene)	Char.
	General	Much char, few volatile products.

[1]Decomposes by a mechanism involving both random- and end-chain scission.

and possibly III are likely to contain the precursors of "soot" and minute soot particles of diameter ~0.01 μm. The yellow luminosity of a diffusion flame is emission from these particles. This provides most of the thermal radiation, which helps to maintain the high surface temperature necessary for sustained burning.

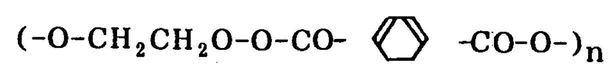
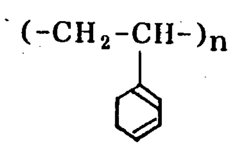
These soot precursors will enter the flame and either be burnt if temperature and oxygen concentrations are high enough, or form particles which leave the flame as "smoke". This is a competition between oxidation and pyrolysis which determines how much smoke is produced from a burning material.

Under conditions of complete combustion, fuel is converted into stable gaseous products. This is a feature of premixed gas/air flames, although if the atom ratio C/O is greater than about 0.5, particulate matter (soot) is formed within the flame, although theoretically soot can be formed, only if the oxygen is not enough to convert the carbon content of the fuel to CO (i.e. C/O >1) (Gaydon *et al.*, 1979). This indicates that the accumulation of soot is determined by the kinetics of the reactions involved. This also applies to diffusion flames where there are large variations in concentration of the reacting species.

The chemical composition of the fuel is very important, as certain fuels, including carbon monoxide and methyl alcohol do not give off soot (or smoke). Table 2.2 shows the percentage of the original mass of certain polymers converted to particulate smoke under flaming conditions involving a constant air flow and a radiant heat flux (Parts, 1972).

A general scheme for the formation of soot was given by Calcraft *et al.* (1975) as a summary of the ideas of a number of workers, thus.

TABLE 2.2: Smoke yield from burning polymers (Parts, 1972).

Polymer	Structure unit	% Conversion (by mass)
PMMA	$(-CH_2-\overset{\overset{\displaystyle COOCH_3}{\vert}}{\underset{\underset{\displaystyle CH_3}{\vert}}{C}}-)_n$	0.6
Polyethylene-terephthalate		5.8
Polyisoprene	$(-CH_2-\overset{\overset{\displaystyle CH_3}{\vert}}{C}=CH-CH_2-)_n$	19.4
Polystyrene		21.0

Hydro carbon fuel

Primary unsaturates (typically C_2H_2)

Aromatic (including polycyclics)

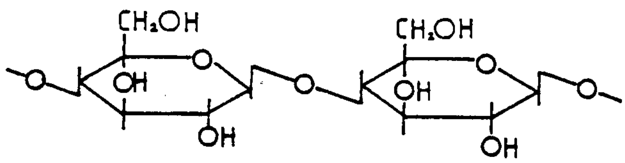
Carbon

polymers (including polyacetylenes)

Acetylenes and polyacetylenes (e.g. C_8H_2) and polycyclic aromatic hydrocarbons (PCAH) have been detected in both premixed and diffusion flames (Bonne *et al.*, 1965). The formation mechanism of PCAHs is not clear; they may be formed directly in pyrolysis of the parent fuel, or they may require the intermediate formation of polyacetylenes (Cullis *et al.*, 1981). Unsaturated fuels (e.g. polyisoprene) and fuels containing the benzene ring (e.g. polystyrene) tend to give a lot of smoke, while oxygen-containing fuels (e.g. PMMA) tend to give much less smoke (Table 2.2). This is because the pyrolysis of unsaturated and aromatic fuels give products which form soot precursors easily.

Under non-flaming combustion, the smoke may consist of liquid drops which are produced by the condensation of high molecular weight compounds found in the pyrolysis product (Bankston *et al.*, 1981). This type of smoke is produced during smouldering. Smouldering occurs only with char forming materials (Drysdale, 1985). Surface oxidation of the char releases the heat necessary to decompose the virgin material next to the combustion zone. Self-sustained smouldering occurs with certain wood products such as fibre insulation board.

Madorsky (1964) reported that there appears to be two mechanisms for the decomposition of cellulose (see formula, wood contains 50% cellulose, 25% hemicellulose and 25% lignin), one leads to the formation of a high-boiling flammable liquid "tar", and the other leads to the formation of char. A study by Madorsky (1964) of the decomposition of



Structure of cellulose

dry cotton cellulose shows that the volatiles can be separated into four fractions (condensed under vacuum in a flow system) as follows:

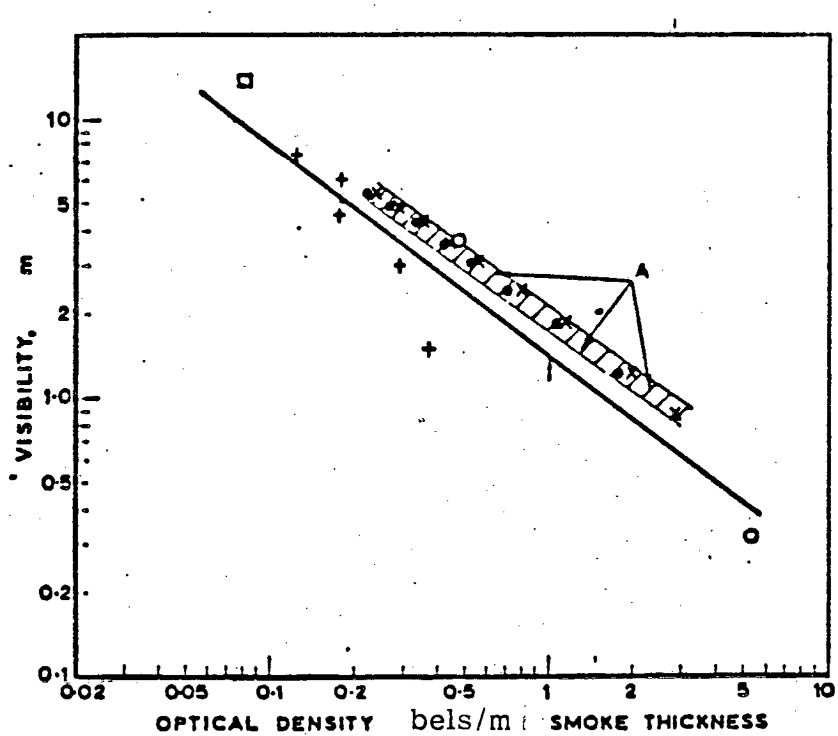
Degradation temperature	Volatile at: -190°C	-80°C	+25°C	degradation temperature
250	7.8%	12.0%	53.9%	23.6%
397	1.7%	6.2%	22.5%	69.6%
main constituent	CO	CO_2	H_2O	"tar"

The fraction designated "tar" contains the combustible volatiles consisting of a high boiling degradation product (e.g. levoglucosan). This shows higher "tar" production at the higher temperature. Much more CO, CO_2 and water are produced at the lower temperature. These gases are not flammable and there is a much higher yield of char. These different mechanisms can account for certain features of smoke formation from wood and wood products.

2.1 Quantitative Expression on Smoke

A major hazard from smoke is the reduction in visibility. Since it is impossible to measure this directly, it has become common practice to measure opacity (which is defined in scientific encyclopedia as "the property of stopping the passage of light rays"), which relates directly to visibility. Rasbash (1967) collected different work to correlate these two parameters. Figure 2.2 shows this relation.

FIGURE 2.2: Relation between visibility and optical density of smoke from fire (Rasbash, 1967).



Relationship between visibility and optical density of smoke from fires

- ● Focused handlamp (150 cd) yellow smoke
- × Focused handlamp (150 cd) black smoke
- □ Illuminated letter sign
- O Illuminated exit sign
- + Diffuse light in smoke chamber
- A Range for focused handlamps (50–600 cd) in yellow smoke
- — Suggested mean relationship

Opacity can be determined by monitoring the attenuation of a beam of light passing through the smoke and is expressed as percentage transmittance (T_p)

$$T_p = \frac{I}{I_o} \times 100$$

Where I and I_o are the transmitted light intensity in presence and absence of smoke, respectively. It has been shown (Foster, 1959) that when light from a tungsten filament lamp passes through wood smoke, an extinction relationship which approximates to Bouguers law is applicable.

$$\frac{I}{I_o} \simeq e^{-\sigma L}$$

where σ = an attenuation coefficient (m^{-1}), and depends on composition of the particles and their size and shape distribution; L = length of light path (m).

In order to define a measure of the smoke which is independent of the measuring system, the optical density per unit length was introduced and defined as

$$D' = -\frac{1}{L} \log_{10}\frac{I}{I_o} \text{ (bel/m)} \qquad \ldots (2.1)$$

where $\log_{10}\frac{I}{I_o}$ is a measure of attenuation and may be assigned the unit of "bels" (bel is a unit for expressing the ratio of two values of power, being the logarithim to the base 10 of the power ratio), although it is actually dimensionless.

Gross *et al.* (1967) assumed that if a sample of material was burnt in a chamber of volume "V"m^3, the opacity of the smoke measured in bel/m would be directly proportional to the area of burning surface (A) and indirectly to the volume of the chamber, thus:

$$D' \propto \frac{A}{V}$$

They called the constant of proportionality "the specific optical density (D_S)", which is equal to

$$D_S = \frac{D'V}{A} \text{ (bel)} \qquad \ldots (2.2)$$

For convenience, the unit decibel (db) is used rather than bel(b): 1 db/m = 10 bel/m. So equation 2.1 for optical density becomes:

$$D = -\frac{10}{L} \log \frac{I}{I_o} \text{ (db/m)} \qquad \ldots (2.3)$$

Seader and Chein (1974) suggested using a more general parameter related to the mass loss, assuming that the optical density is directly proportional to the mass of material burned (W_L), this is called mass or standard optical density (D_o), which is equal to

$$D_o = \frac{D\,V}{W_L} \text{ (db/m).m}^3\text{/gm} \qquad \ldots (2.4)$$

Rasbash and Phillips (1978) introduced the term "obscura", equal to 1 db/m (note obm³/gm ≡ (db/m).m³/gm).

In this project, smoke yield is expressed in terms of the obscuration potential per gram of material burnt, i.e. as the smoke potential, D_o, with unit ob.m³/gm.

In the small compartment test, two types of smoke potential D_o have been measured, the D_o was calculated by equation 4 and this will be referred to as D_o(static). Secondly, Woolley *et al.* (1979/80), in Fire Research Station, and Babrauskas (1977), in National Bureau of Standards, determined the smoke yield by measuring the D_o(dynamic), the same measurement used in this project (Section 3.2). The D_o(static) is a measurement for the accumulated smoke (cool), while the D_o(dynamic) is a measurement for the hot smoke as it flows from the compartment. The volume of smoke (V_s) is calculated as follows (Woolley *et al.*, 1979-80):

$$V_s = \int D \cdot V_f \cdot dt \quad ob.m^3 \qquad \ldots (2.5)$$

D is taken as the optical density (per metre) of the smoke flowing from corridors, V_f is the volumetric rate of discharge of the fire gases from the corridor.

Equation 2.5 gives the total amount of smoke in terms of the volume which has an optical density corresponding to 1 ob. The dynamic smoke potential (D_o,dynamic) is then obtained from:

$$D_o(\text{dynamic}) = \frac{V_s}{W_L} \quad ob.m^3/gm$$

where W_L is the weight loss.

2.2 Review of Smoke Tests

A number of methods have been developed in recent years for measuring the smoke producing potential of materials. Although there are more than fifteen standards throughout the world, there is still a lot of uncertainty with regard to the applicability of laboratory smoke measurement to predict smoke development under real fire conditions.

Before designing an acceptable standard which is relevant to real fire conditions, there are some questions which must be answered, which are (Rasbash and Drysdale, 1982):

(a) If fire breaks out in a building, at what stage of the fire is smoke generation most significant vis-à-vis life safety?

(b) Which is more important: the rate of smoke production or the total smoke yield?

(c) In a test, should smoke yield be measured as an optical density or as a mass of particulate matter?

(d) Should smoke generation be expressed in terms of unit surface area of the sample or of unit mass of the volatiles?

A simple comparison for fifteen different tests has been presented by Malhotra *et al.* (1982) (Table 2.3). Nine of these tests used the static measurement for smoke while the others used appropriate dynamic methods. A report of the Technical Sub-committee on Fire Risk (1978) makes the following statement: "... Discussion has been in progress for some years now in scientific circles, both nationally and internationally, on various alternative methods for measuring smoke production, without so far any positive outcome ...". Despite this, the demand for improving the existing methods or creating a new test for smoke measurement is continuing.

Eight tests have been chosen here for review.

2.2.1 Steiner tunnel test (ASTM E84 - 1967)

This is a test widely accepted in the U.S.A. for measuring the surface flame spread rating of materials (Figure 2.3) and was developed by Steiner ASTM E84 (1967). The test involves burning a large sample of material (7.5 x 0.45 m), mounted face down to form the roof of a 7.5 m tunnel. The sample is ignited by two gas burners, 300 mm from the fire end of the sample and 190 mm below the surface of the sample. The test lasts 10 minutes. The flame spread rating is made relative to an arbitrary scale with values for asbestos = 0, and red oak = 100. Smoke measurements are made with a vertical photometer system through the tunnel near the exhaust end. The smoke absorption/time curve is

Test reference	Specimen size/ orientation	Heat source	Exposure range	Primary application contents/ lining	Chamber size for smoke accumulation	Photometer path length mm
1. AUSTRALIAN Test for Early Fire Hazard AS 1530 Pt 3	600 x 450 x } normal thickness mm Vertical	Radiant panel 300 x 300 mm + pilot flame 12 mm high x 6 mm diameter	Not specified, Time/temp. for blank 355°C in 5 min	Lining	Hood above apparatus	305
2. CANADIAN Smoke Test Can. 4 S102	1 - 40 g on load cell	Vertical tube furnace + spark for ignition of volatiles	Temp. 300-700°C Variable O_2/N_2 mixture	Contents	Dynamic flow of smoke in chimney	-
3. FRENCH Smoke Test NF-T51-073	0.2 g	Horizontal tube furnace 40 mm diameter	Temperature - 1000°C, O_2/N_2 mixture at 300 l/h	Contents	2 litre vessel, smoke stirred prior to measurement	-
4. GERMAN Smoke/Toxicity Test DIN 53437/ 53436 (Smoke test now withdrawn)	400 x 15 x 2 mm horizontal	Moving furnace over horizontal tube 40 mm diameter 1 m long	Temperature - 300-600°C Air/nitrogen at 100 l/h	Contents	Dynamic flow of smoke in tube	320
5. JAPANESE Smoke Test for Building Materials JIS A1321 pt 3	220 x 220 x } 15 mm vertical	Radiant furnace + pilot flame	Temperature - 750 ± 10°C	Lining	Box for smoke accumulation	250
6. DUTCH Flashover test Nen 3883	290 x 290 x } 60 mm vertical	Panel of heating coils + row of Pilot flames	Electrical input 2250 W	Lining	Dynamic flow of smoke above box	220
7. SCANDINAVIAN Nord Test NT Fire 004	225 x 225 x } 11 ± 2 mm (4 pieces) sides and top of box	Gas burner with LPG	Temperature - 350°C in 5 minutes	Lining	Dynamic flow of smoke in flue pipe	-

TABLE 2.3: Main features of smoke tests (Malhotra, 1982).

Test reference	Specimen size/ orientation	Heat source	Exposure range	Primary application contents/ Lining	Chamber size for smoke accumulation	Photometer path length mm
8. UNITED KINGDOM BS DD 36 Proposed Standard now withdrawn	229 x 229 x } 50 mm vertical	Radiant element + pilot flame	4 - 5 W/cm^2	Lining	15 - 35 m^3 room	Room volume 33.7 m^3
9. UNITED KINGDOM BS 5111 Smoke generation from cellular plastics and rubber	25 mm cube	Small jet propane gas flame	~3 W/cm^2 gas flame ignition only	Contents	790 x 300 x 300 mm cabinet	300
10. AMERICAN ASTM E84 Steiner Tunnel Test	500 x 7500 mm horizontal	Gas flame	5000 BTU/min	Lining + structural elements	Dynamic flow of smoke at exhaust end of tunnel	-
11. AMERICAN ASTM E268 8 ft Tunnel Test	346 x 2440 mm horizontal	Radiant steel plate + small pilot flame	3.5 - 0.6 W/cm^2	Lining	Dynamic flow of smoke at exhaust end of tunnel	-
12. AMERICAN ASTM E162 Radiant Panel Test	150 x 450 mm x thickness 30° to vertical	Gas/air mixture burning on porous refractory panel + pilot flame at upper edge	~670 ± 4°C	Lining	Smoke and products drawn into hood	-
13. AMERICAN ASTM E662 NBS Smoke Test	76 x 76 x } 50 mm vertical	Radiant furnace + pilot flame	2.5 W/cm^2	Lining	914 x 914 x 610 mm	914
14. AMERICAN ASTM D2843 XP2 Smoke Test	25 x 25 x 6 mm	Gas flame	Only gas flame ignition. ~3 W/cm^2	Contents	790 x 300 x 300 mm cabinet	300
15. INTERNATIONAL ISO Test DTR 5924	165 x 165 x 70 mm horizontal	Radiant conical furnace (BSDD/70)	1 - 5 W/cm^2	Lining	1.28 m^3	360

TABLE 2.3: Main features of smoke tests (continued).

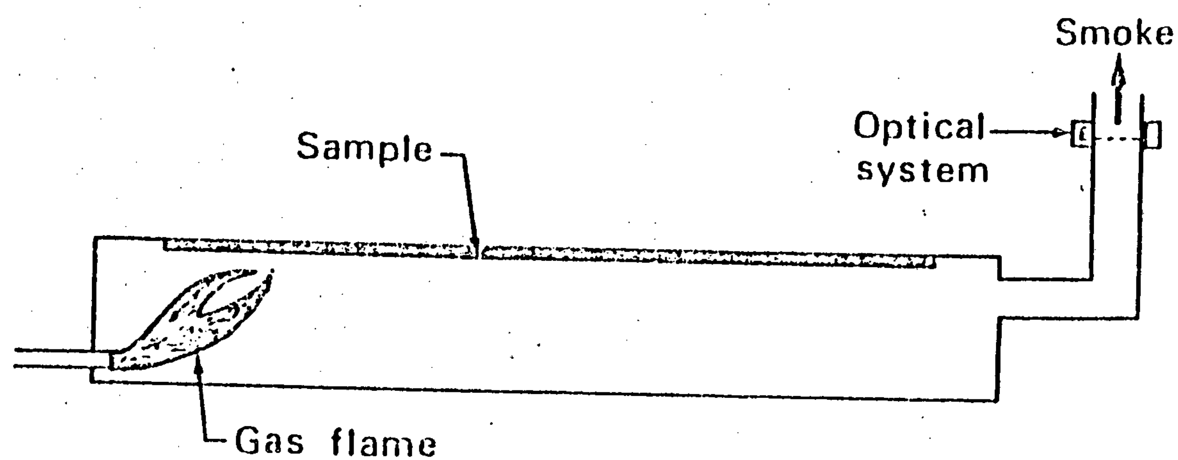


FIGURE 2.3: Steiner tunnel test (Malhotra, 1982).

plotted, and the area under the curve obtained is taken as a measure of the total quantity of smoke produced.

Shern (1967) modified the way of the smoke measurement by relating the smoke production from the test to visibility, by allowing the smoke to accumulate in a room 14.8 x 2.44 x 3.63 m. The accumulated smoke which has been stirred and also cooled and stabilised was measured with obscuration system shining across the room. The results of the obscuration measurements, which were presented as per cent obscuration, were compared with the impression of observers inside and outside the room. Shern observed that:

"(a) It is wrong to use the smoke values obtained from the tunnel test to define the acceptability of material, tunnel test values standing alone without reference to time or volume surface limits can be misleading. Values of 50 (% obscuration) for smoke developed in the tunnel test produce untenable atmospheres. Values as low as 15, if the smoke is allowed to collect in a fire area or room, will produce untenable atmospheres within the 10 minutes exposure in the tunnel;

(b) The relationship between measurement with the obscuration and impressions of observers in the cell were subject to wide variations between observers and between tests because of differing irritant effects;

(c) The results of the opacity measurements for the accumulated smoke (using observers, some with breathing apparatus and others without) were considerably more repeatable than measurements made in the tunnel flue."

For the results of Shern (1967), D_o has been calculated by the author of this thesis, assuming the weight loss is 80% of the initial weight. Douglas fir and Red oak have D_o values of 0.25 and 0.22 ob.m^3/gm, respectively, for samples of thickness 9.5 mm and width

38 mm. When the thickness and width of the red oak sample was increased to 25.4 and 63.5 mm, respectively, the D_o value decreased to 0.13 ob.m^3/gm (see Section 5.1.2.3(a)).

2.2.2 *Rohm-Haas X P-2 chamber test (ASTM-D-2843-70)*

The test chamber was the first designed specially to measure the smoke production of materials.

A sample measuring 25 x 25 x 6 mm is burnt by immersing it in premixed propane/air flame and the smoke produced is collected in a cabinet of 0.07 m^3. The opacity of the smoke is measured with a horizontal light beam of 0.3 m path length located below the ceiling. The results are reported as per cent obscuration, but the volume of the chamber is so small that many materials are quoted as giving 100% obscuration (Figure 2.4). Another problem with this test is that the light beam shines horizontally across the chamber, and will be affected by stratification of smoke within the box. Furthermore, Rasbash and Phillips have pointed out, because the comparatively small sample immersed in a flame, some of the smoke produced may be burned off. However, it is a simple test and useful to distinguish "good material from bad".

2.2.3 *National Bureau of Standards chamber test (ASTM E662-79)*

Gross *et al.* (1967) developed what is commonly known as the NBS chamber. The test involves exposing an area of the sample (65 mm x 65 mm) to a thermal radiation flux of 2.5 W/cm^2 (Chapter III), inside the chamber which has a volume of 0.51 m^3. An array of six small pilot flames is used to establish flame at the face of the sample if smoke from flaming combustion is to be determined. The results are expressed

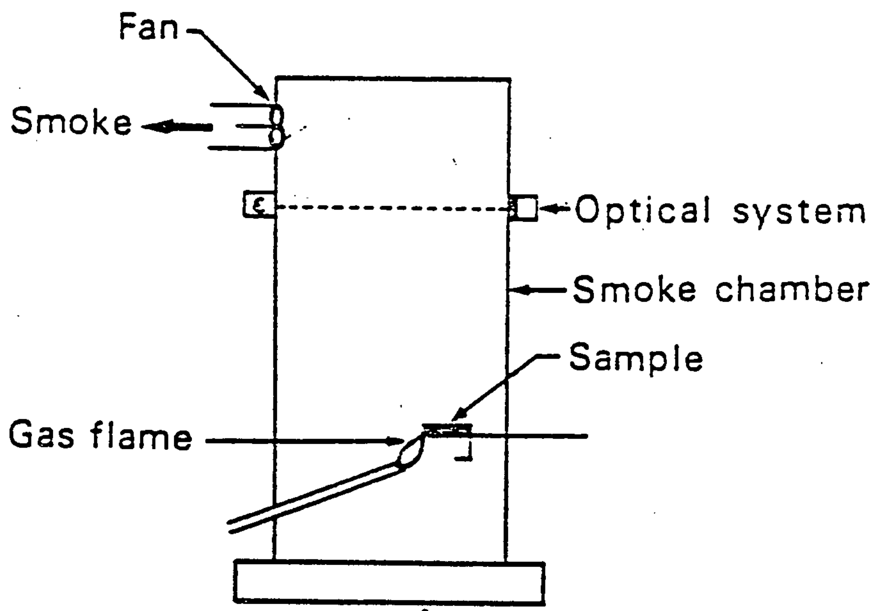


FIGURE 2.4: Rohm-Haas XP-2 chamber test (Malhotra, 1982).

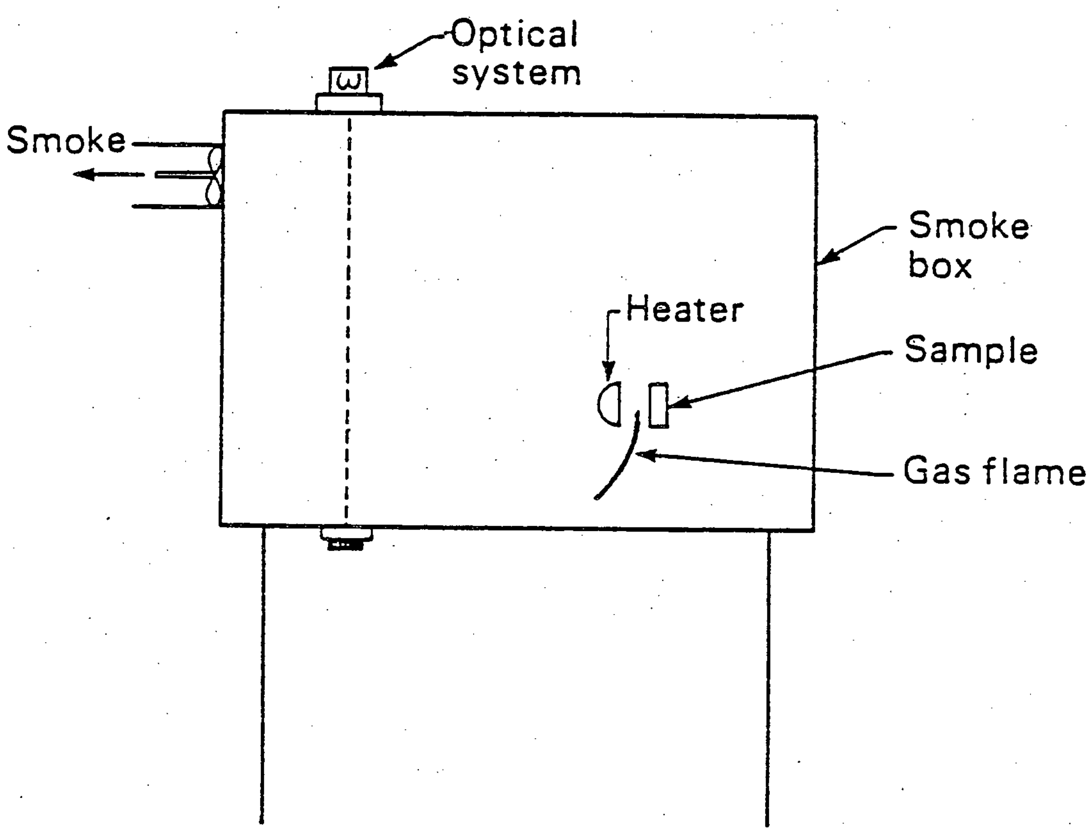


FIGURE 2.5: NBS chamber test (Malhotra, 1982).

in terms of specific optical density (equation 2.2). As the chamber is small (Figure 2.5), it is possible that oxygen depletion will be a problem with some materials. The reproducibility and repeatability of this test is better than other smoke tests, although a variability of ±25% is still to be anticipated (Lee, 1971).

2.2.4 *Edinburgh University chamber test (Phillips, 1976)*

This test was based on the NBS test, the main difference being the use of a larger chamber (13.75 m^3). Thus, the smoke has a chance to mature and oxygen depletion effects are avoided. The smoke production furnace was designed to provide a thermal exposure to the sample surface similar to that provided by the combustion unit of the NBS smoke test (Section 3.12). The opacity of the smoke is measured by vertical beam, 2.2 m in length and expressed in obscura (equation 2.3). The sample measures 75 x 75 mm and is wrapped in aluminium foil, one face being exposed by cutting away the foil, it is then weighed and exposed in the chamber to a heat flux of 2.5 W/cm^2 until a maximum obscuration is recorded. The residue is weighed to find the mass of material which has volatilized. The smoke potential is then calculated using equation 2.4.

2.2.5 *Arapahoe chamber test (ASTM D4100-82*

This is a gravimetric test, consisting of a small chamber, in which the sample is burnt in a premixed propane/air flame. The combustion products are drawn through a filter (Figure 2.6). The sample is very small, 38 x 12.7 x 3 mm. The weight of the smoke is determined by weighing the filter before and after the test, the difference being the weight of the smoke. As mentioned in Section 2.2.1 for the XP-2 test, some of the smoke may be burnt in the flame here also.

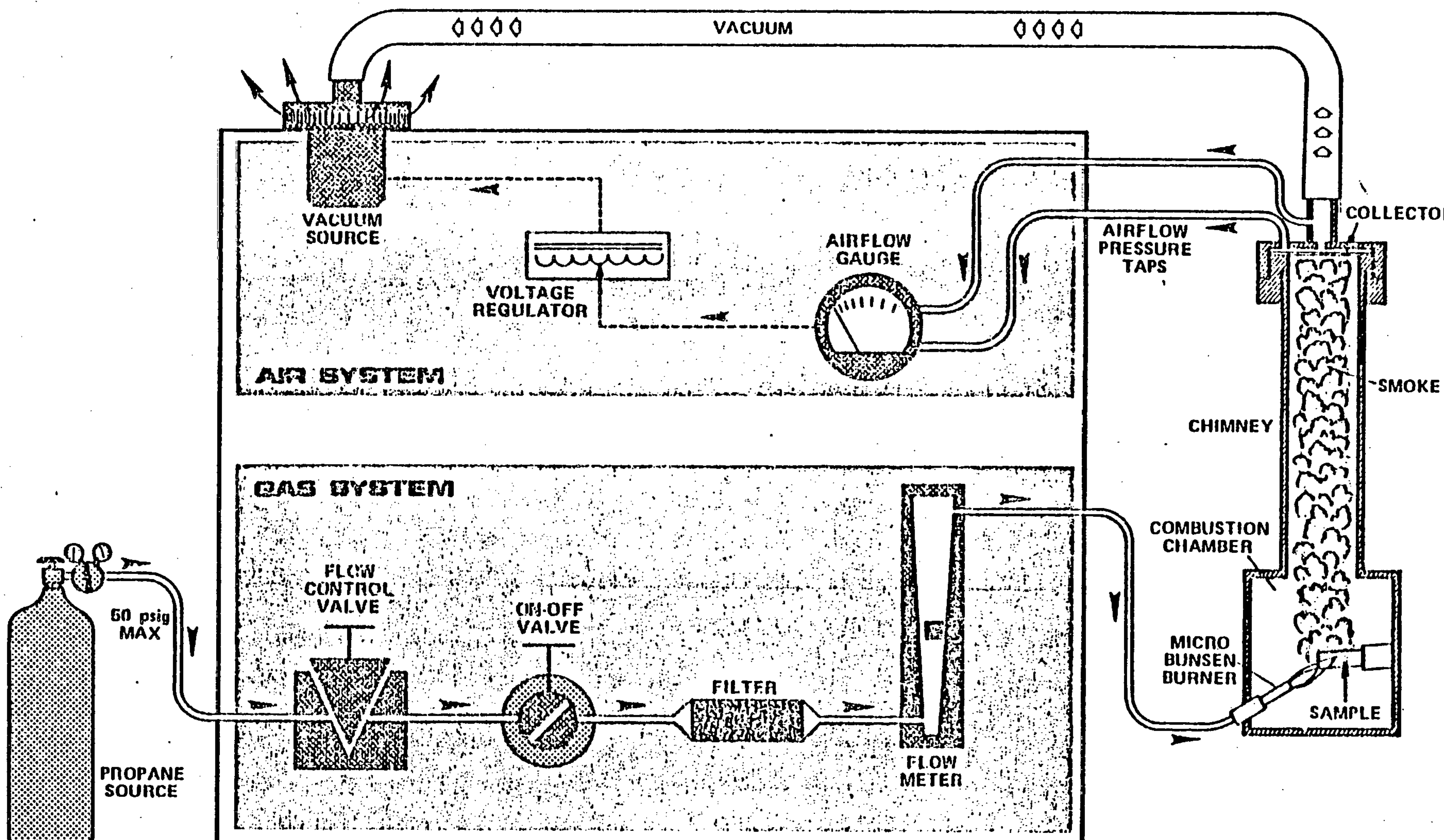


FIGURE 2.6: Arapahoe smoke chamber test.

2.2.6 *Smoke test NF-T51-073 (French test, 1977)*

The apparatus (Figure 2.7) is essentially a 40 mm diameter annular quartz tube furnace operated at selected temperature up to 1000°C with air, nitrogen or nitrogen/oxygen mixtures passed through the furnace at a rate of 300 l/h. A sample weighing 0.2 gm is placed in a porcelain boat in the middle of the furnace. A stream of smoke traverses the glass tube (1 m) beyond the furnace and homogenized in a magnetically stirred vessel of 2-litre capacity. The smoke opacity is measured by a lamp/photo cell placed beyond the vessel. An air stream (15 l/h) passes across the windows to prevent the deposition of soot on them. The problem with this test is the very small sample size, specially for dense materials. In addition, for composite materials (e.g. plywood), the sample may not be representative of the material. Furthermore, there is the unknown effect of stirring and the small volume of the vessel.

2.2.7 *Proposed BS 476, Part 9*

This test is one of the tests where the apparatus built for a completely different purpose is adapted for smoke measurement (as shown in Figure 2.8a). Thus, it has a lot of disadvantages. The fire propagation test (BS 476, part 6) apparatus, which was designed to assess the fire proprerties of wall lining materials, involves exposing a sample of area 230 x 230 mm to gas flame and electrical heater in a box furnace. The box has an air vent at the bottom and a chimney at the top. The test lasts for 20 minutes. The gas burner is adjusted to give 530 watts for the duration of the test, but after 2 min 45 sec, the electric heater is operated at 1800 watts. At five minutes into test, this is reduced to 1500 watts and maintained at this level. This apparatus was modified as a smoke generator by Stark and Hasan (1967). They sealed the top

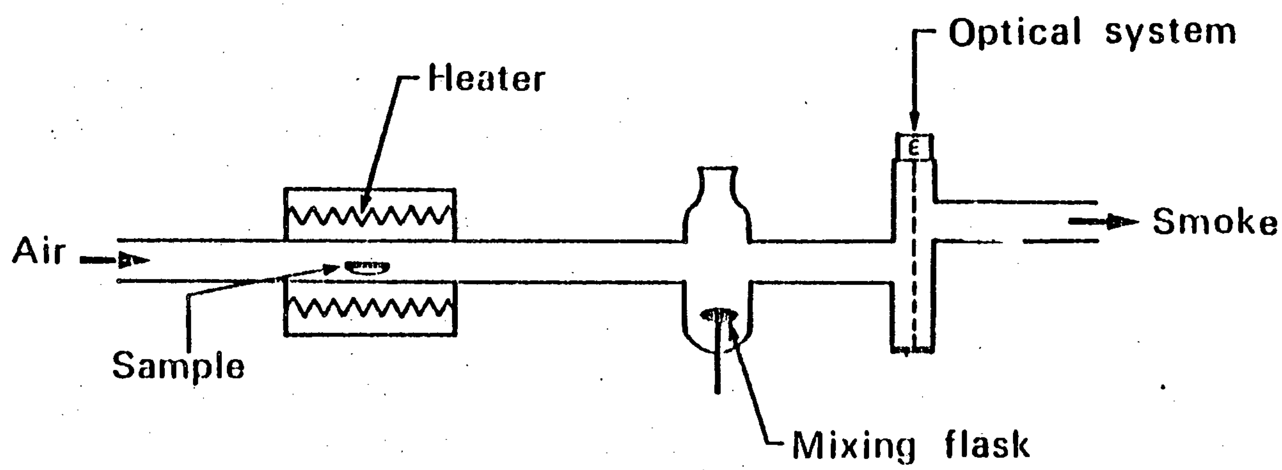


FIGURE 2.7: French test (NF.T51-073) (Malhotra, 1982).

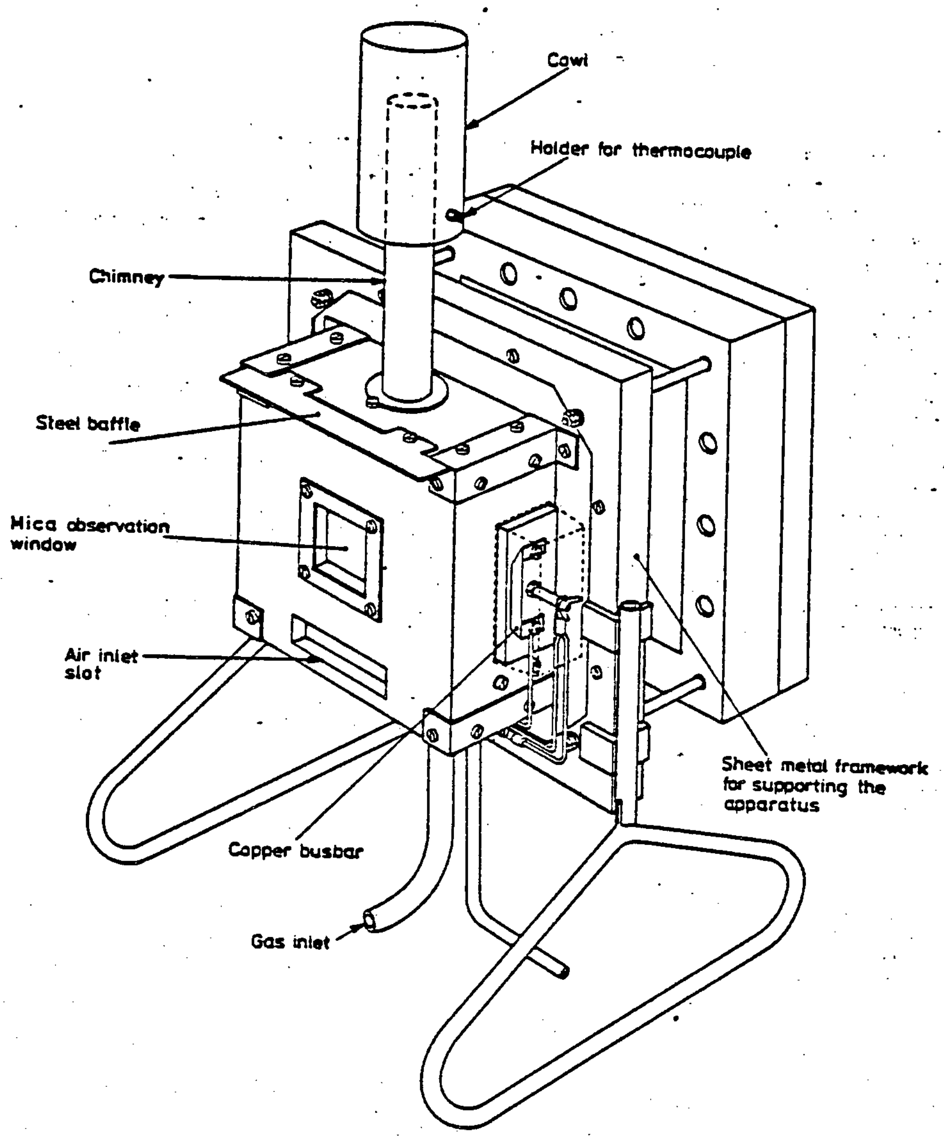


FIGURE 2.8a: Diagrammatic representation of the propagation test (BS 476 : Part 6 : 1981).

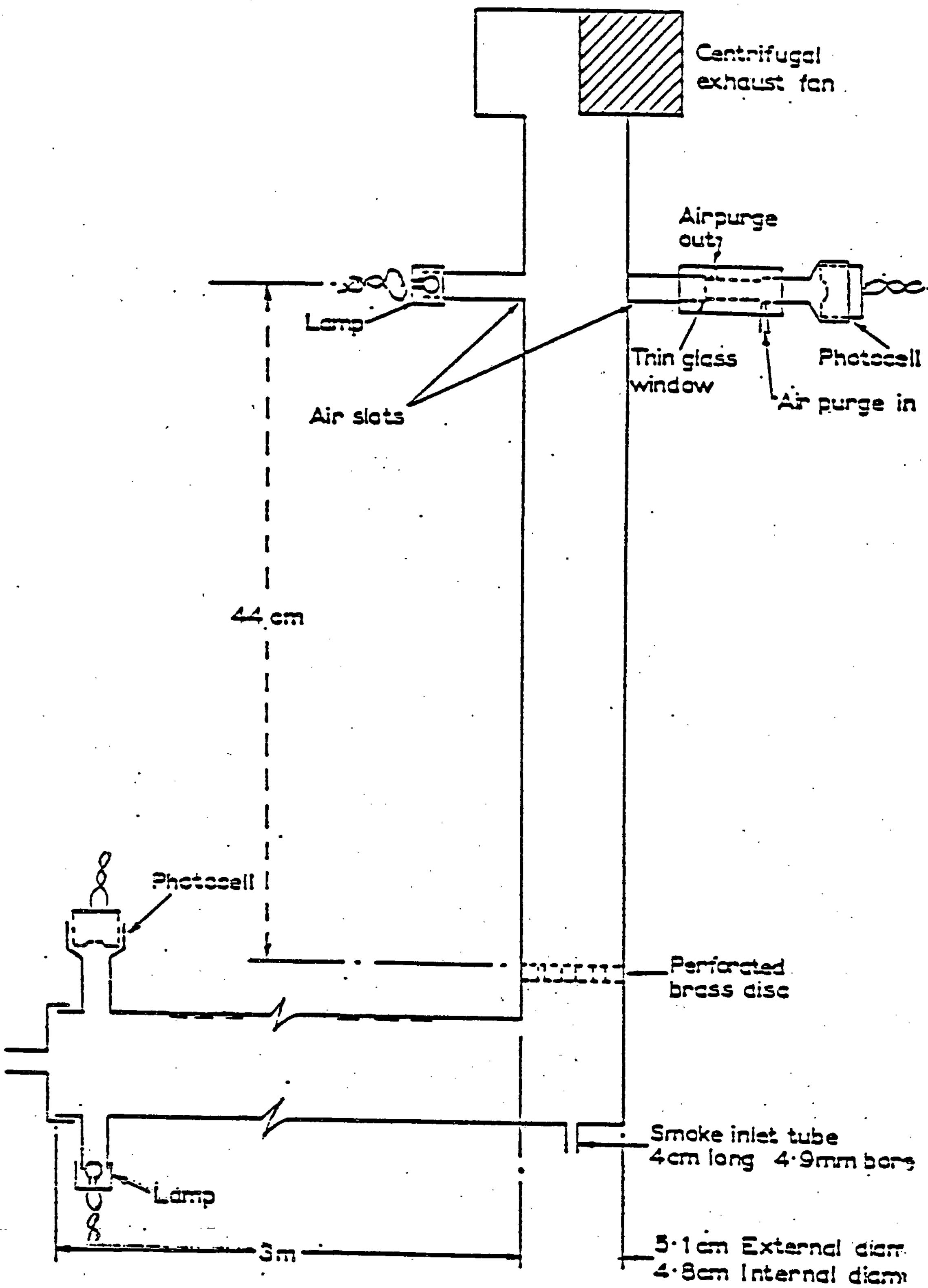


FIGURE 2.8b: Smoke measuring apparatus (Stark and Hasan, 1967).

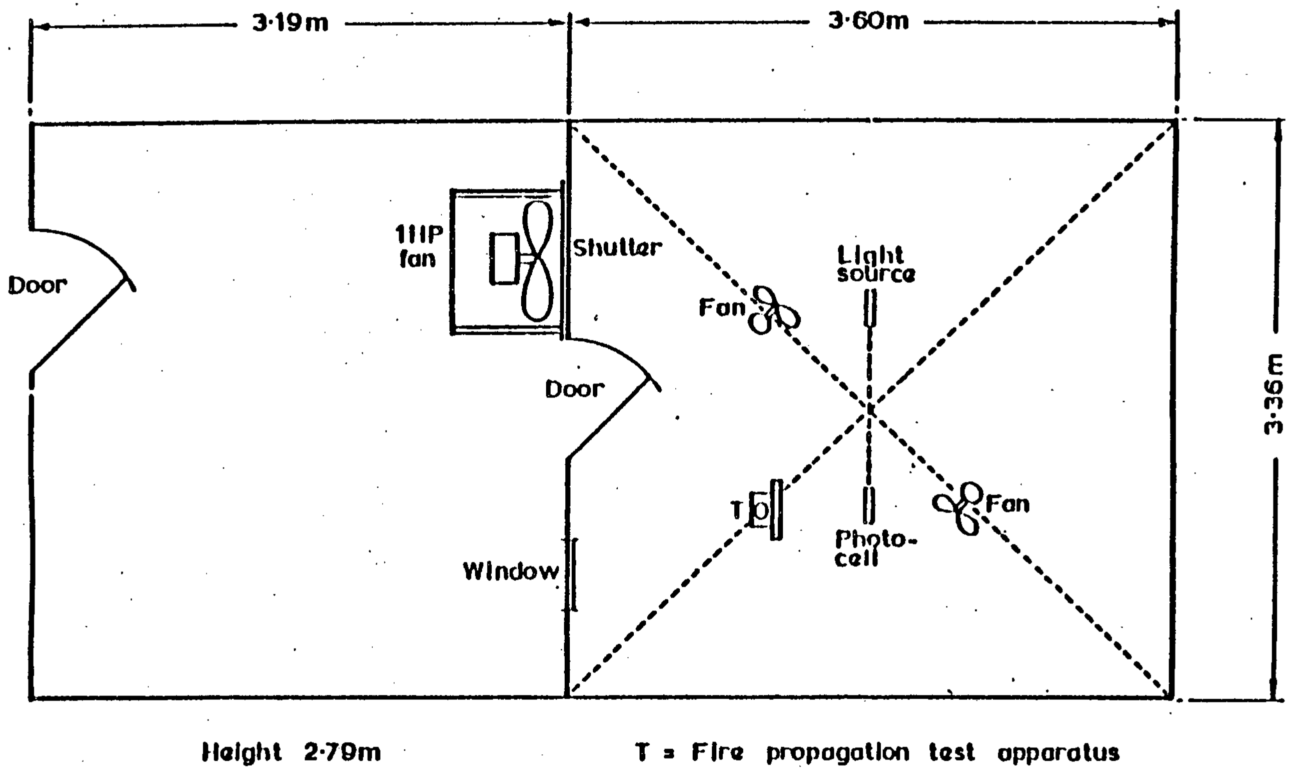


FIGURE 2.8c: Test chamber general arrangement (plan) (Bowes and Field, 1969).

of the cowl and then drilled a central hole into which a small tube of the smoke apparatus was a push fit. The specimen holder was changed to be horizontal to avoid the loss of materials (by dripping or melting).

The smoke from the fire propagation apparatus is then diluted to known extent with cool air. ("This is desirable to ensure the condensation of the volatiles, contributing to the smoke and hence affecting its optical density..", Stark and Hasan, 1967). The smoke measurement was carried out in the apparatus shown in Figure 2.8b, which consist of a tube through which the smoke and the clean air are drawn by means of a fan. The clean air is drawn from a remote place away from the fire propagation apparatus to avoid contamination with smoke. The ratio of smoke drawn from the apparatus and clean air is controlled by an orifice cap on the part admitting clean air. The transmittance of smoke/air mixture is measured with a photocell near the top of the tube. Stark and Hasan concluded that the sampling and dilution system had certain limitations with some problems of the smoke sampling tube as it became clogged with soot.

Bowes and Field (1969) used the fire propagation apparatus (BS 476, part 6) but allowed the smoke produced to accumulate in a closed compartment of 33.7 m^3, containing two fans to circulate the smoke and avoid stratification. The opacity of the accumulated smoke is measured by a horizontal light beam. Instead of the 20 minutes time specified in the fire propagation test, they left the sample till a maximum obscuration was reached (Figure 2.8c). For non-flaming test, the test is carried out without the gas jet and reduced electrical power. The optical density and the specific optical density can be calculated by equations 1 and 2. The disadvantages of this method are the large volume of the chamber which may lead to poor reproducibility when a small amount of smoke is produced, and the need to stir the smoke with an unknown effect. In addition to that is the use of the horizontal light beam, although a fan used for stirring, but still no guarantee that there is a complete mixing for smoke.

2.2.8 The ISO smoke chamber - "Munich-box" (International Standards Organization, 1980)

The Munich box test incorporates the ISO ignitability test (without a pilot ignition source) (Figure 2.9). This apparatus comprises a smoke chamber 1.2 m^3 in two sections, between which the smokey gases are continuously circulated by means of a fan. An electric heater capable of providing radiant fluxes in the range of 1-5 W/cm^2 at the centre of the sample (165 x 165 x up to 70 mm thick). An obscuration device is used to measure the smoke. The proposed procedure involves measuring the maximum optical density of the smoke per unit surface area of the sample at five levels of radiant heat. Each test takes fifteen minutes. Malhotra *et al.* (1982) reported that "some smoke formed in tests may be burned by the furnace at the higher intensity value, the enclosure size for measurement may be too small and produce errors in trying to measure very dense smoke.".

2.3 Parameters Affect Smoke Yields

In a standard test, the material decomposes or burns under conditions specific to that test, which might or might not be representative of what is happening in a real fire. It has been observed that changing some of the conditions of the test, can change the smoke yield significantly. These variations can be divided into two main groups as presented in Table 2.4.

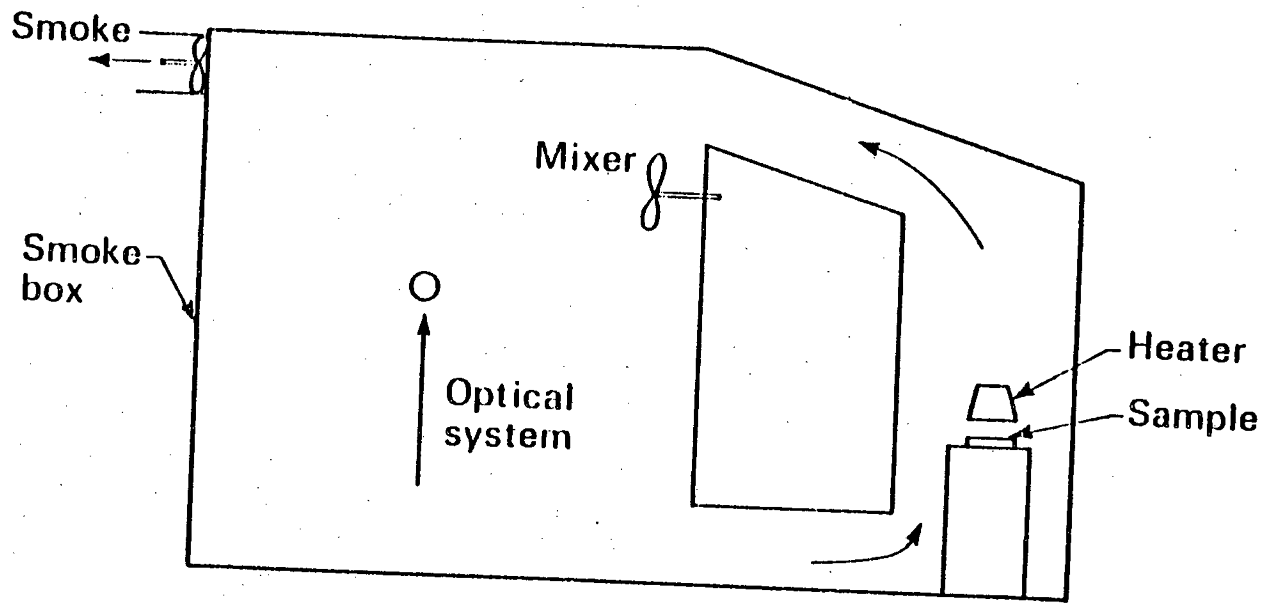


FIGURE 2.9: ISO smoke test (Malhotra, 1982).

TABLE 2.4: Variables in the test conditions.

- **Material variables**
  - **Chemical**
    - *Chemical compositions*
    - *Fire retardant*
    - *Surface coating*
    - *Type of combustion*
  - **Physical**
    - *Thickness*
    - *Density, thermal conductivity and capacity*
    - *Orientation*
- **Environmental variables**
  - *Ventilation*
  - *Oxygen concentration*
  - *Space temperature*
  - *Heat flux*

2.3.1 *Material variables*

2.3.1.1 *Physical variables*

(a) Thickness

Thickness has been identified as an important factor which affects the smoke yield. Most of the standard tests refer to the thickness in one way or another. In some tests, thickness is specified (e.g. XP-2 test); in some, the normal thickness is used provided that it does not exceed a limit value (e.g. NBS and ISO tests), while others accept the normal thickness of the material, whatever its value (e.g. Australian test AS 1530, Pt 3). There are two in which the weight is specified with no mention of thickness at all (e.g. the Canadian test, Can.4 S102, and the French smoke test, NF-TS1-073). Most of the work done to test the effect of the thickness on smoke yield expressed as D_s shows an increase in the smoke with increasing thickness. While some researchers noticed a direct proportionality, some others did not. It is likely that the difference is due mainly to the variation in weight loss but, to the best of my knowledge, nobody has studied the effect of thickness on the smoke potential (D_o), although Seader and Chein mentioned that "... the mass optical density is less dependent on the sample thickness and surface area of the sample ...", but they did not support it with any data.

Hilado (1970) tested few materials (α-Cellulose and PVC) by NBS test under flaming and non-flaming. His results showed no proportionality for PVC, while for α-cellulose there was an acceptable proportionality between thickness and the smoke yield (D_S) (Table 2.5). The data from Gaskill (1970) also found a proportionality for α-cellulose. Figure 2.10 shows data cited by Lee (1973) for elmwood under non-flaming conditions with NBS chamber test, again an acceptable proportionality is shown.

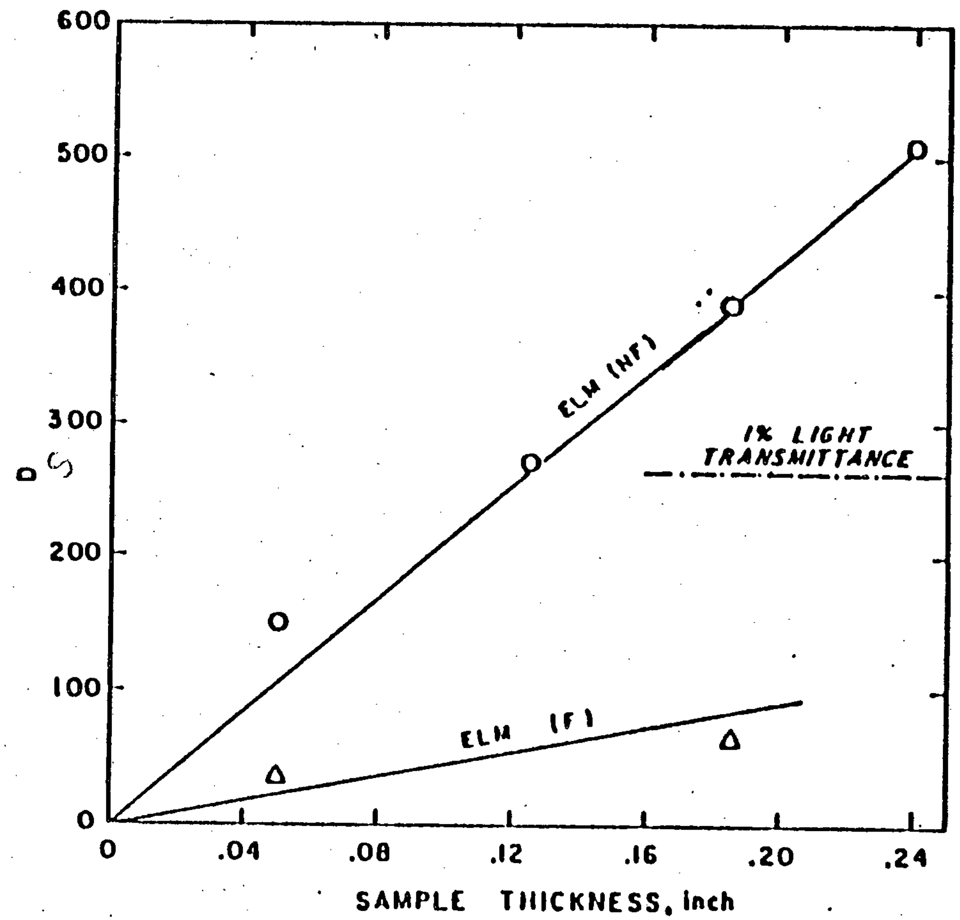


FIGURE 2.10: Effects of thickness on specific optical density for elm (Lee, 1973).

TABLE 2.5: Effects of thickness on smoke yield.

Material	Thickness	D_s (bel)	D_s/ thickness	
α-cellulose	0.75 (mm)	162	216	non-flaming
	1.50	296	197	
	2.25	398	177	
	3.00	709	236	
PVC	0.40 (mm)	11	0.7	non-flaming
	0.50	23	1.2	
	1.08	139	3.3	
	0.40	98	6.2	flaming
	0.50	153	7.8	
	1.08	326	7.7	

(b) Density, thermal conductivity and thermal capacity

The rate of decomposition of any material depends on temperature, the rate of temperature rise depends on thermal inertia ($K\rho C$) for thermally thick material or thickness for thermally thin material (where K is thermal conductivity, ρ density and C is the thermal capacity; while the thermal conductivity is strongly dependent on density, thermal capacity is independent of the material form). Figure 2.11 shows some materials with different thermal inertia, the low thermal inertia material (e.g. fibreboard and polyurethane) heats quickly if subjected to an imposed heat flux (Drysdale, 1982) and releases smoke much quicker than the other materials which have higher thermal inertia. The amount of heat which is transferred through to the rear of the sample depends on the thermal thickness $\sqrt{\alpha t}$ of that material, where α is the thermal diffusivity ($K/\rho C$) and t is the exposure time. K, ρ and C are defined above. Little work has been done in testing different densities, as it is very difficult to get two or more samples which are identical chemically and differ only in their densities.

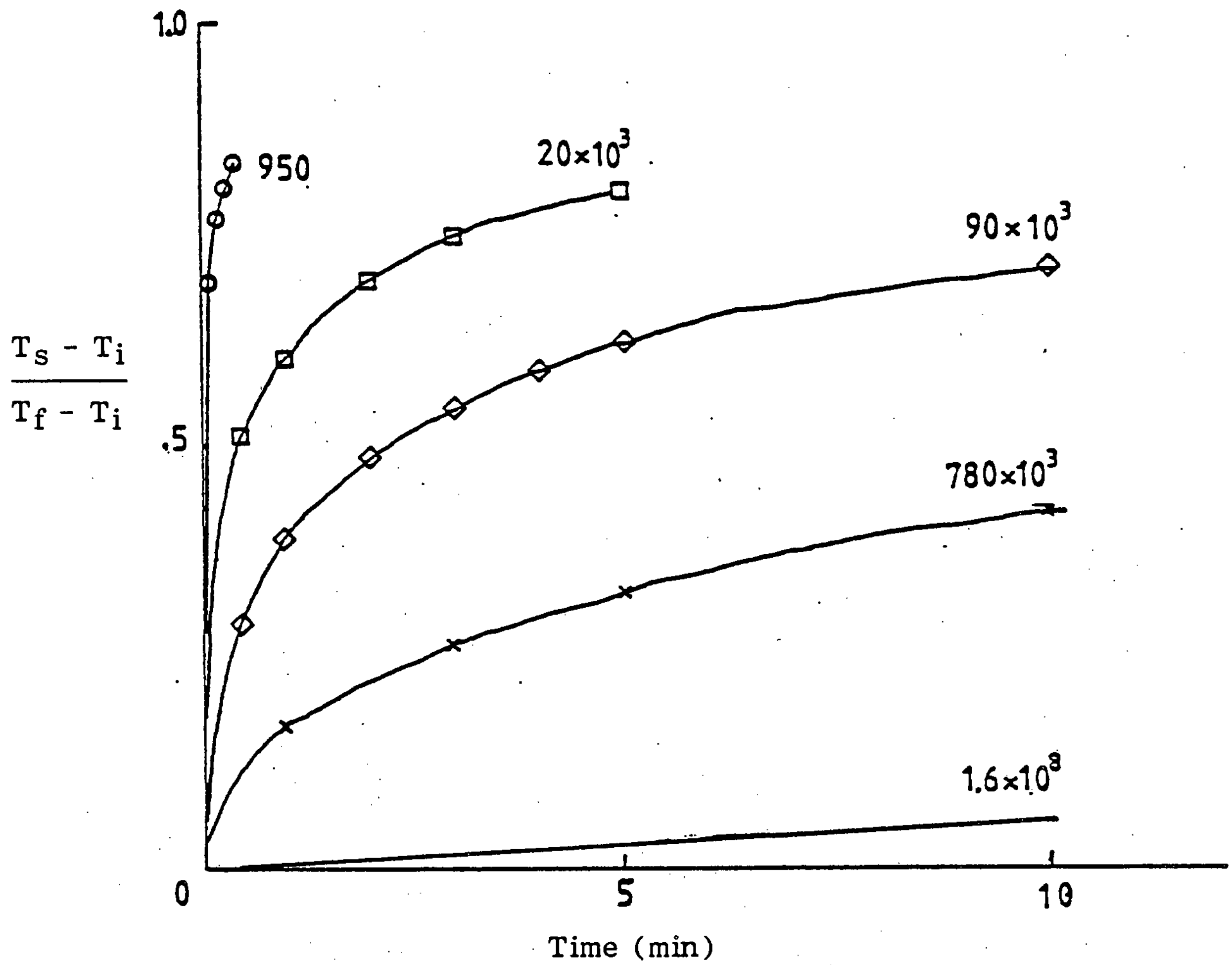


FIGURE 2.11: Effect of thermal inertia on the rate of temperature rise at the surface of a semi-infinite solid.

(steel ——; oak x—x; asbestos ◇—◇; fibreboard ⊟—⊟; polyurethane foam o—o)

T_s = surface temperature; T_i = initial temperature;

T_f = final temperature.

Hilado (1970) carried out several tests with an NBS chamber under flaming and non-flaming conditions for rigid urethane foam with different thickness and densities. Rigid urethane of varying densities was prepared by reacting polyoxypropylene ethers based on sorbitol and hexanetriol with polymeric diphenylmethanepolyisocynate. The density of each formulation was controlled by adjusting the amount of water used to generate carbon dioxide blowing agent. Table 2.6 shows the results.

TABLE 2.6: Effects of density on smoke yield.

	Flaming:			Non-flaming:		
Thickness (mm)	Density (kg/m^3)	D_S (bel)	D_o* (obm^3/gm)	Density (kg/m^3)	D_S (bel)	D_o* (obm^3/gm)
6.3	43	45	0.62	42	49	0.67
	55	47	0.52	55	62	0.71
	143	90	0.38	141	158	0.66
	276	161	0.35	275	363	0.78
	576	486	0.50	718	718	0.75
12.7	41	80	0.58	41	70	0.26
	53	95	0.53	53	103	0.29
	123	112	0.26	119	272	0.66
	259	220	0.26	279	580	0.66
	550	710	0.39	569	658	0.36
	975	333	0.10	984	789	0.24
25.4	42	71	0.26	43	111	0.39
	56	124	0.58	56	195	0.51
	121	134	0.17	116	446	0.55
	265	311	0.18	277	652	0.37
	566	529	0.14	592	652	0.17
	1019	737	0.11	997	661	0.10
50.8	44	113	0.20	45	221	0.38
	55	119	0.17	55	272	0.37
	118	183	0.12	124	499	0.32
	270	270	0.08	270	647	0.18
	613	789	0.10	622	714	0.09
	1101	449	0.03	1074	626	0.05

*calculated by the author of this thesis

The smoke potential (D_o) is calculated by the author of this thesis by assuming that 50% of the material was consumed (Phillips, 1976). There is no clear correlation between density or thickness with smoke potential, this might be due to the 50% weight loss assumption which there is some doubt about. This is because adding the water in the preparation process, the cross linking of the polymer may be changed, which will change the char yield.

(c) Orientation

Again, here the orientation of the sample is different in different standard tests. In many, the sample is in the vertical position (e.g. NBS, the Australian, the Japanese, the Dutch, etc.), while other standards use the horizontal position (e.g. American Steiner Tunnel test and the ISO test). The orientation of the sample is one of the important factors in the fire, as there is a big difference between a fire involving a carpet on the floor and one involving a carpet hung, for example, as a lining material. In addition, there is the effect of dripping from dripping and melting materials in vertical position.

Breden and Meisters (1976) reported the effects of orientation by modifying the NBS chamber to take a sample in the horizontal position (Figure 2.12). They tested two different groups of materials, thermoplastic and non-thermoplastic. Table 2.7 (overleaf) shows the results.

The effects of orientation on smoke yield is more significant with the thermoplastic materials than non-thermoplastic, which is mainly due to the dripping characteristic of the thermoplastic. Breden and Meisters reported better repeatability for thermoplastic with horizontal position than vertical.

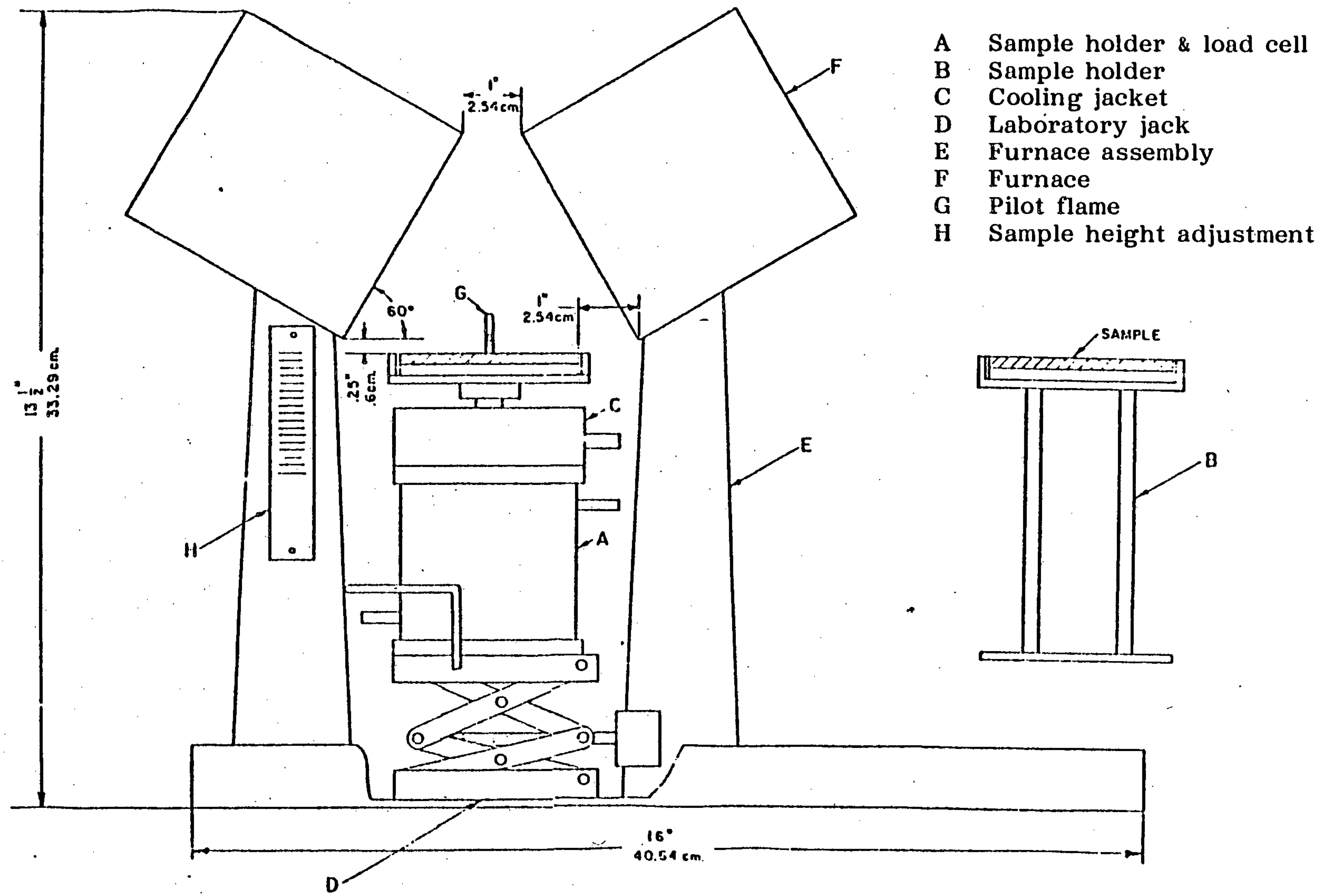


FIGURE 2.12: Horizontal configuration.

TABLE 2.7: Comparison of vertical and horizontal position on smoke yield.

Group	Material	D_S (bel) (flaming)* horizontal	vertical
Thermoplastic	polypropylene	398	57
	polyethylene	286	35
	Nylon 6,6	264	48
	paraffin wax	228	83
Non-thermoplastic	phenolic impregnated paper	155	140
	vulcanized fibre	52	63
	Elm (4 mm thick)	59	57
	Balsawood	16	8

*Materials, except elm, were tested in 1.5 mm thickness.

The results of Bankston *et al.* (1978) supported those of Breden and Meisters for thermoplastic (PVC), while the Douglas fir (non-thermoplastic) behaved as the PVC in this work, i.e. more smoke recorded with horizontal than vertical positions. They give a reason for this as "the effective heating rate in horizontal position is greater than the effective heating rate in vertical position." Kanury (1975) recorded the heat transfer rate by convection for a horizontal flat plate is about 10% higher than that of a vertical plate.

The results are shown in Table 2.8 for non-flaming combustion.

TABLE 2.8: Effects of sample orientation on smoke yield.

Material	O.D. (ob) horizontal	vertical
Douglas fir	38.7	15.7
PVC	14.9	5.5

With PVC, the residue left at the end of the test was 3% of the initial weight for horizontal position compared with 30% for vertical, which is mainly due to the dripping effect. The authors did not mention the initial weight of the sample or the weight loss to calculate the D_o, but from the residue content it can be predicted that the D_o for horizontal is nearly double that of the vertical D_o.

2.3.1.2 Chemical variations

(a) Chemical composition

The chemical nature of the fuel is of fundamental importance. Thus certain fuels, e.g. methylalcohol, do not give soot (or smoke), while others under certain conditions give substantial yields (Rasbash and Drysdale, 1982). Polystyrene as an example (where the aromatic nucleus released into the gas phase) (Tables 2.1 and 2.2), produce huge amounts of smoke because the polymer breaks down to give mainly monomer, with dimer, trimer and tetramer making up the balance. While the polyethylene terephthalate, the aromatic nucleus is part of the backbone of the molecule and the cross-linking which occurs during the decomposition process inhibits the release of aromatic nuclei with the volatiles, hence, less particulate smoke is generated (Cullis and Hirscher, 1981).

(b) Surface coating

Most of the work done to test the effect of surface coating on smoke yield has been concentrated on the substrate itself, neglecting the fact that with a surface coating there are two materials involved. Other workers simply treated the combination of substrate and coating as a single material with different thickness (Seader and Chien, 1974). Seader and Chien (1974) have concluded that, "It would appear that the effect of coating is at present unpredictable". This conclusion can be true when studying the results of work done by Gross *et al.* (1967) and another by Gaskill (1970).

Gross *et al.* (1967) found that with the majority of surface coatings on plywood, the specific optical density was reduced for both flaming and non-flaming conditions. However, Gaskill (1970) found specific optical density for wallboard was decreased under flaming and increased under non-flaming conditions when coated with epoxy polyamide.

(c) Fire retardent

Different chemical substances have been added to the combustible materials for the purpose of reducing the flammability. It is often found that retarded polymers produce more smoke than normal grades. Work by Einhorn *et al.* (1968) supported this hypothesis as they noticed that an addition of reactive phosphate to flexible urethane foam led to doubling the light obscuration rate. When phosphorous and chlorine have been added to the rigid urethane, the same behaviour was noticed. These results were supported by work reported by Brown and Dunn (1976) using the XP.2 test. Two materials tested (melamine paper laminate and glass reinforced polyester), the specific optical density was higher for the materials with fire retardent. However, Edgerley and Pettett (1980) noticed that there is no significant difference in specific optical density as a result of adding fire retardent (4% antimonytrioxide and 10% dechlorane 515 ($C_{18}H_8Cl_{12}$) to three materials tested in NBS chamber under non-flaming conditions (polyethylene, polypropylene and polystyrene). Results of Hamoudi *et al.* (1977/78) for polyacrylnonitrile with and without retardent, showed different behaviour as the specific optical density increased when the fire retardent added under non-flaming conditions, while there was no significant change under flaming.

Unfortunately, in spite of a considerable research, effort has been directed towards the reduction of flammability of organic materials by different additives, but very little done to study the effect of these additives on smoke yield. Hilado (1968) studied the relation between the two for seven additives on the Douglas fir plywood using the 2.4 m tunnel furnace method and measured the smoke index and the flamespread index. Figure 2.13 (a,b) show the best two fire retardents ($NH_4H_2PO_4$ and $ZnCl_2$) increased the smoke index by three to four times, while a material, such as NaCl, did not affect the smoke yield, but at the same time it is a very poor retardent. The problem of balancing flammability and smoke production must be considered carefully, as it may be hazardous to gain on one side but lose on the other.

(d) Mode of combustion

Most of the work mentioned above has shown the differences between flaming and non-flaming conditions regarding smoke production. Most of the standard tests can be carried out for both types of exposures, e.g. the NBS test, although others are limited to one mode of combustion, e.g. Arapahoe test.

Bankston *et al.* (1978), when testing different materials under flaming and non-flaming combustions, noticed that the particles generated in the absence of flame appeared as tarry droplets, while under flaming conditions the particles appeared as fine black soot.

Phillips (1976) studied the smoke yield from different materials for both types of combustion using the E.U. chamber test (Section 2.2.3). His results are presented in Table 2.9. The results show significant higher smoke potential (D_o) from non-flaming compared with flaming combustion for all materials studied, except for the rigid polyurethane foam.

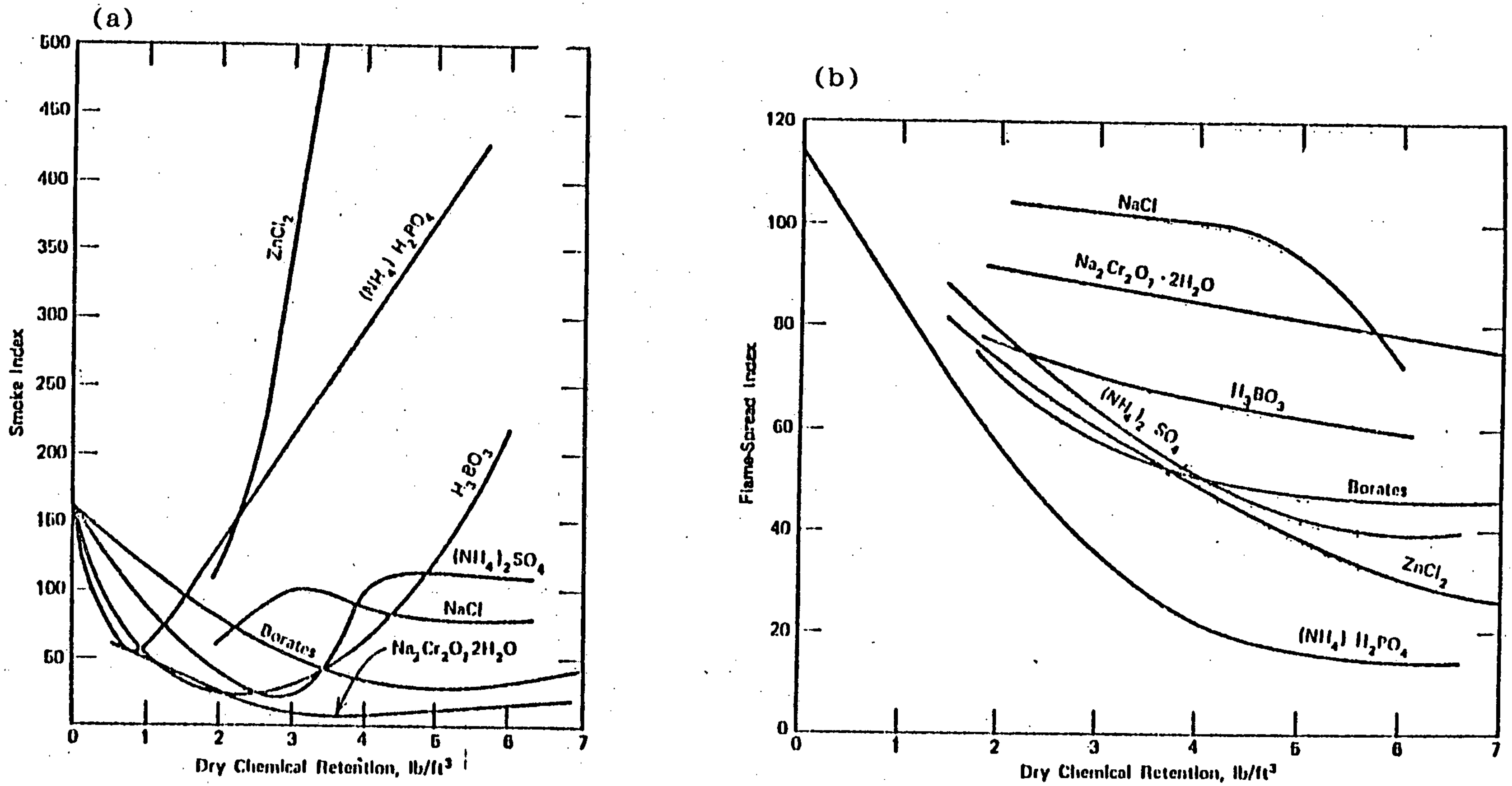


FIGURE 2.13: Relationship of (a) smoke density and (b) flame spread to level of chemical retention in percentage of Douglas fir plywood evaluated by the 8-foot tunnel furnace method (Hilado, 1968).

TABLE 2.9: The smoke yield from different materials (Phillips, 1976).

Material	Flaming D_s (bel)	Flaming D_o (ob.m³/gm)	Non-flaming D_s (bel)	Non-flaming D_o (ob.m³/gm)
Fibreboard	273	0.60	775	1.80
Chipboard	492	0.37	2353	1.90
Hardboard	130	0.35	622	1.70
Birch plywood	213	0.17	709	1.70
External plywood	65	0.18	491	1.50
Cellulose paper	15	0.22	158	2.40
Rigid PVC	291	1.70	298	1.80
Extruded ABS	764	3.30	731	4.20
Rigid polyurethane foam	228	4.20	87	1.70
Flexible polyurethane foam	33	0.96	177	5.10
Plasterboard	9	0.04	71	0.39

2.3.2 *Environmental variables*

(a) Ventilation and airflow

Ventilation (and airflow) is one of the important parameters affecting smoke yield in any fire, but most of the standard tests involve either a sealed chamber or a restricted airflow. Varying in the test to examine the effect of ventilation is not only difficult to achieve but also difficult to interpret as the smoke is continuously diluted.

Nevertheless, some experiments have been reported in which the effect of ventilation on the smoke yield has been investigated. Gaskill (1970) modified the NBS chamber test to enable him to find the effect of ventilation. The modification involves the addition of a regulated ventilation system, consisting of a 2.5 mm diameter inlet tube from a compressed air supply and flow regulator to a horizontal closed-end cylinder (2.5 mm diameter) located back to front in the lower right-hand side of the chamber. A variable width slit cut longitudinally in the bottom of the cylinder permits the formation of a uniform sweep of air through the box from the lower right side upward to the left and out through the (open) exhaust part. Ventilation rates up to 20 chamber changes per hour are possible with this system. Some of the results from Gaskill are presented in Table 2.10 (non-flaming).

TABLE 2.10: Effect of ventilation on maximum smoke density.

Material	no ventilation	D_s (bel) $(t_m)_{min}$	Non-flaming 6 change/hour	12 change/hour	20 change/hour
Phenolic canvas laminate (a)	450	28	295	160	80
Phenolic canvas laminate (b)	460	35	270	205	95
PVC (rigid)	490	30	235	160	120
Silicon rubber	240	30	105	-	35

(a) = non-fire retardent; (b) = fire retardent.

The above results show a reduction on specific optical density as a result of increasing the ventilation which might be due to the dilution effect. The effects of ventilation on wood under non-flaming was greater than that under flaming conditions (Figure 2.14) (Gaskill did not integrate the smoke production).

Edgerely and Pettett (1978) used the French test (NF-T51-073) apparatus to test different materials with different ranges of airflow (2.5 to 10 litres per metre). The results are shown in Table 2.11. The smoke density seems to have been little affected by different airflow rates at 400°C.

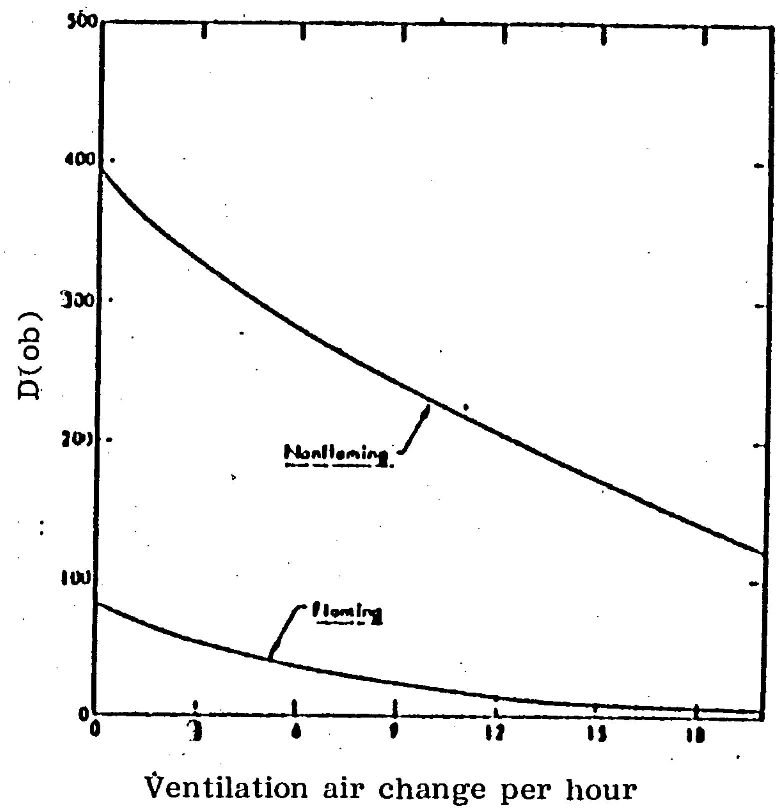


FIGURE 2.14: Effect of ventilation on specific optical density of red oak.

TABLE 2.11: Effect of airflow rate on smoke density (non-flaming).

Material	D_s Flow rate 2.5 l/m	Flow rate 5.0 l/m	Flow rate 7.5 l/m	Flow rate 10 l/m
Deal	203 *(2)*	303 *(2)*	219 *(2)*	304 *(2)*
Natural rubber	401 *(3)*	522 *(4)*	530 *(4)*	484 *(3)*
Polypropylene	663 *(5)*	691 *(5)*	675 *(5)*	604 *(4)*
Extruded PVC	113 *(1)*	118 *(1)*	204 *(1)*	161 *(1)*
Styrene butadiene rubber	466 *(4)*	434 *(3)*	505 *(3)*	764 *(5)*

The flow rate of 2.5 l/m has been taken as the base to rank the materials under different flow rates (Table 2.11). Extruded PVC and the deal kept their ranking as the first and the second, respectively. Polypropylene, which is the highest under the flow rate of 2.5, 5.0 and 7.5 l/m, changed its position to be the fourth with a flow rate of 10.0 l/m. The natural rubber and the styrene butadiene rubber changed their ranking between third and fourth, except for styrene rubber which, with 10 l/m flow rate, drifted to be the worst (fifth).

The ventilation and airflow parameter needs more study to find the exact effect on smoke yield, as with the above study the effect is variable.

(b) Oxygen concentration

Malhotra (1982) stated, "For NBS chamber, accurate measurements are not possible with materials that produce very dense smoke and may lack air because of the small chamber volume for their combustion". Rasbash and Phillips (1978) also repeated that the NBS chamber may not always be large enough to prevent significant oxygen reduction. Roberts

(1964) calculated the theoretical requirements (gm air/gm fuel) for wood as 5.7, 4.6 for volatiles (empirical formula $[-CH_2O-]_n$) and 11.2 for char. As the weight of air in the NBS chamber (0.51 m^3 volume) is calculated as 614 gm at 20°C, this means that a sample of wood about 130 gm of weight will consume all the oxygen inside the chamber. As an average weight for a typical sample size of wood for NBS standard is ~30 gm, this means that at the last stages of the test, the concentration of O_2 in the chamber is reduced to 15%. A polystyrene sample of around 60 gm is enough to consume all the oxygen. At the end of the test a concentration of 14% of O_2 expected for a typical sample weight of 18.0 gm. For the EU chamber, the typical samples of 30 and 18 gm for wood and polystyrene, respectively, reduce the O_2 in the chamber by 1% for wood and 1.1% for polystyrene only.

Stepniezka (1974) found that identical polymeric materials may produce different smoke densities at different oxygen concentration. Results from King (1975) support the results of Stepniezka. Figure 2.15 shows the results of five materials (plasticised and rigid PVC, Red oak, ABS and polystyrene) tested by King under two oxygen concentrations. First was the ordinary air (21% O_2) and the second 15% O_2 produced by purging with nitrogen until this level was obtained. The tests were carried out using the NBS chamber test under flaming conditions. The different oxygen concentration had a different effect on smoke yield but the greatest effect was on ABS smoke yield.

The above variation of oxygen concentration on smoke yield was also found by Edgerley and Pettett (1978), using the French test NF-T51-073 (Section 2.2.5), with two different oxygen concentrations, namely normal air and 10% O_2. The results are shown in Table 2.12. When the materials listed in order of D_s, nylon 6.6, deal and polypropylene

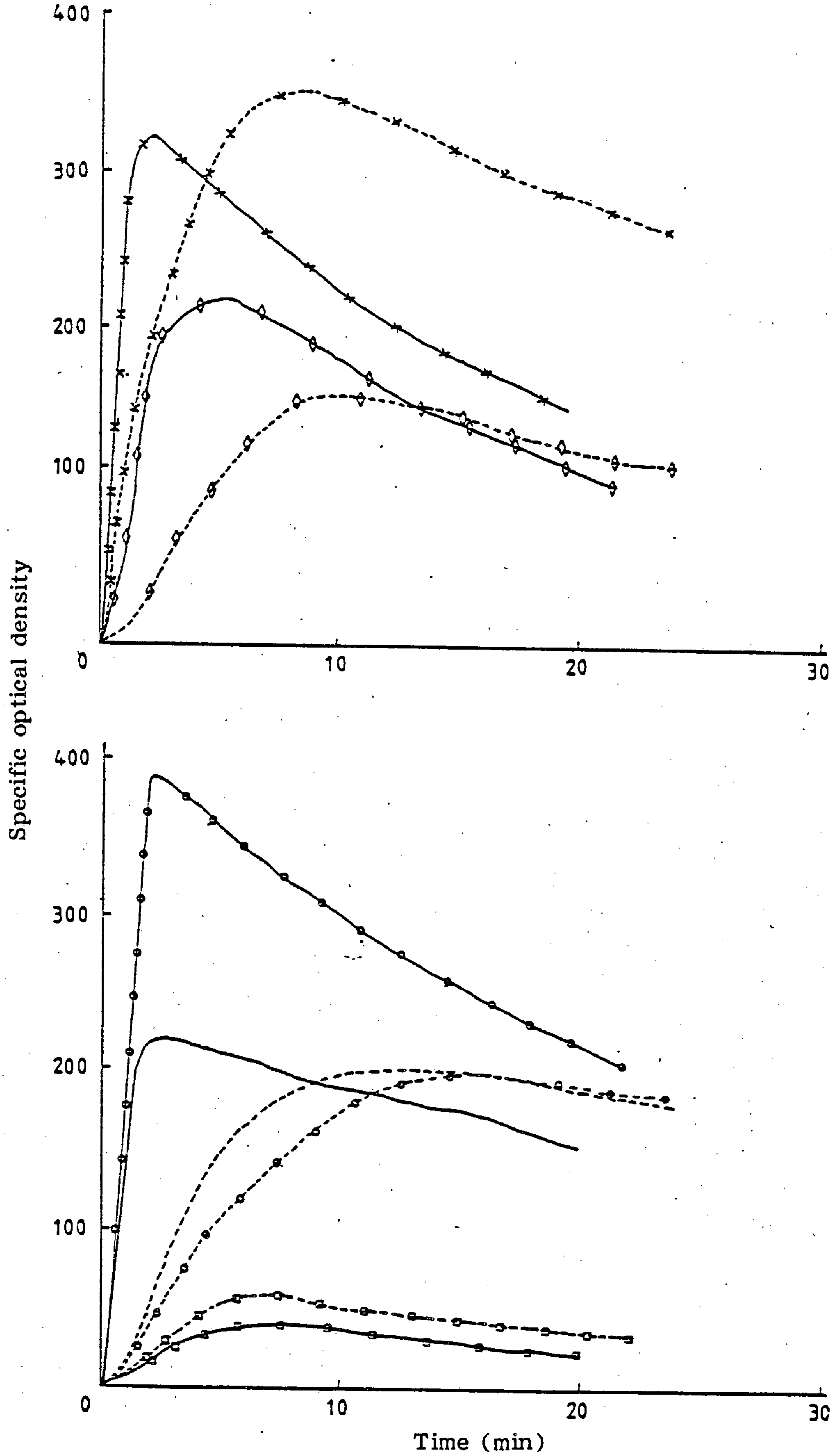


FIGURE 2.15: Smoke variation with chamber oxygen.

—— 21% O_2; ---- 15% O_2.

x = plasticized PVC; □ = red oak; ◊ = rigid PVC
o = ABS; plain = PS

appeared in the same place in the list, 1, 4 and 8, respectively, for both oxygen concentration, the order of other materials seemed to change.

TABLE 2.12: Smoke variation with oxygen concentration.

Material	D_S Air (21% O_2)	D_S 10% O_2
Deal	251 *(4)*[1]	252 *(4)*
Natural rubber	614 *(6)*	738 *(7)*
Wool	186 *(3)*	255 *(5)*
LD polythene	341 *(5)*	0 *(2)*
Polypropylene	747 *(8)*	1106 *(8)*
Polystyrene	673 *(7)*	440 *(6)*
U PVC	29 *(2)*	58 *(3)*
Nylon 6.6	0 *(1)*	0 *(1)*

[1]Numbers in parenthesis are the list order.

Bankston *et al.* (1978) studied the same effect using the ventilated combustion product test chamber (Figure 2.16). Three materials were tested (Douglas fir, rigid polyurethane and PVC) under three oxygen concentrations: (i) normal air; (ii) 80% N_2, 10% O_2 and 10% CO_2; and (iii) 80% N_2, 5% O_2, 10% CO_2 and 5% CO. The results are presented in Table 2.13 which show that for wood and polyurethane, the smoke yield was reduced under restricted oxygen, while for PVC, the smoke density was higher under 10% O_2 concentration than under the ordinary air, and then decreased when the concentration of O_2 decreased to 5%.

TABLE 2.13: Smoke density under different oxygen concentrations.

O_2 concentration	Optical density Wood	Optical density Polyurethane	Optical density PVC
Air (21% O_2)	24.8	2.2	11.7
80% N_2, 10% O_2, 10% CO_2	19.5	1.7	16.1
80% N_2, 5% O_2, 10% CO_2, 5% CO	14.8	1.6	11.4

For any standard test for smoke, the chamber volume should be carefully studied to prevent any oxygen depletion, which is obviously affecting the smoke yield.

(c) Space temperature

Convective heat transfer is affecting surface temperature and thus the rate of rise of this temperature.

Bankston *et al.* (1978) studied this effect, using the combustion product chamber (Figure 2.16) to test wood (Douglas fir) and polyurethane foam under flaming and non-flaming combustion. The smoke measured as it was hot, after dilution with air and making a correction to the volumetric flow rate of the heated air. The results are presented in Table 2.14 and show that for flaming, peak optical density tends to increase with increasing temperature. However, for non-flaming, the opposite behaviour was noticed, as the temperature increased the peak optical density decreased. This may be due to the fact that under low temperatures, the smoke has a better chance to condense.

TABLE 2.14: Smoke density at different environmental temperatures

Temperature (°C)	Optical density (ob)			
	Douglas fir		Polyurethane	
	flaming	non-flaming	flaming	non-flaming
25	-	10.7	2.6	24.9
100	-	8.6	2.7	9.5
200	0.9	7.4	3.5	2.2
300	1.9	-	4.9	(negligible)[1]

[1] The authors did not define what was the yield of smoke they regarded as negligible.

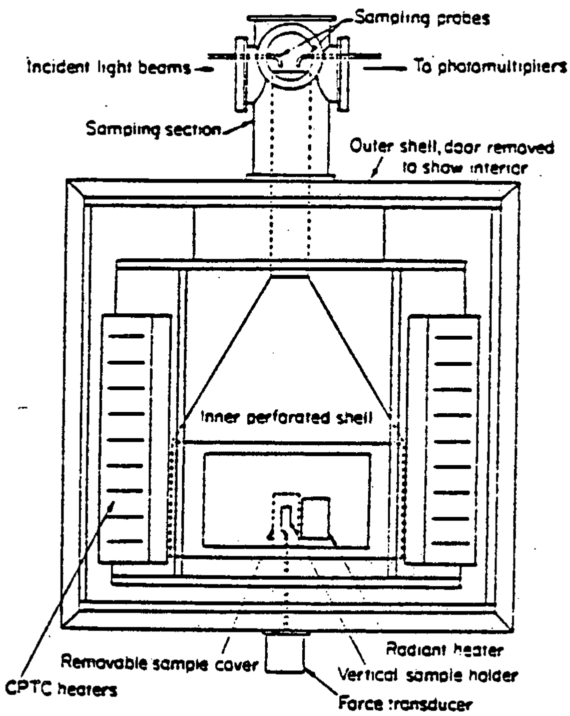


FIGURE 2.16: Combustion products test chamber (CPTC).

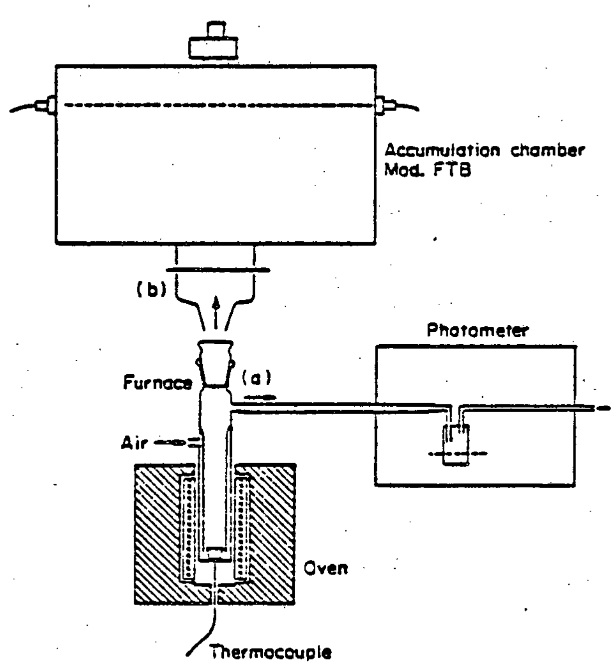


FIGURE 2.17: Scheme of the smoke density measurement apparatus. Mode (a) dynamic; mode (b) accumulation method.

The results of Powell *et al.* (1979) show the same trend as the results from Bankston (1978) for wood (except under non-flaming at 200°C which increased instead of decreased). Powell used the combustion product chamber (Figure 2.16) with a modification into the heater in order to conduct tests at higher environmental temperatures. The results are presented in Table 2.15.

TABLE 2.15: Effects of environmental temperatures on smoke yield.

Temperature (°C)	Optical density (ob)			
	Douglas fir		PVC	
	flaming	non-flaming	flaming	non-flaming
25	0.6	15.7	20.4	5.5
100	1.0	12.1	22.3	5.3
200	2.1	15.2	32.9	7.1
300	4.6	11.0	51.7	12.7
400	9.5	-	66.2	-

Smoke yield from PVC was also studied by Ballistreri *et al.* (1981). Using a combustion chamber (Figure 2.17), where air was heated and circulated in the space between the two quartz tubes and entered the inner tube at the bottom where the sample of 50 to 500 mg placed in the porcelain crucible. Their results showed the same trend as with results from Powell *et al.* (1979) if the smoke density (optical density) at 100°C is dropped from the series, although Ballistreri's work carried out at higher temperatures than that of Powell's work. Ballistreri's results showed that increasing the temperature increased the smoke density until around 500°C where auto ignition occurred (Figure 2.18). This difference in experimental temperatures make the validity of the comparison in doubt. It is hard to make a general conclusion for the effect of environmental temperature on smoke yield as only three materials have been

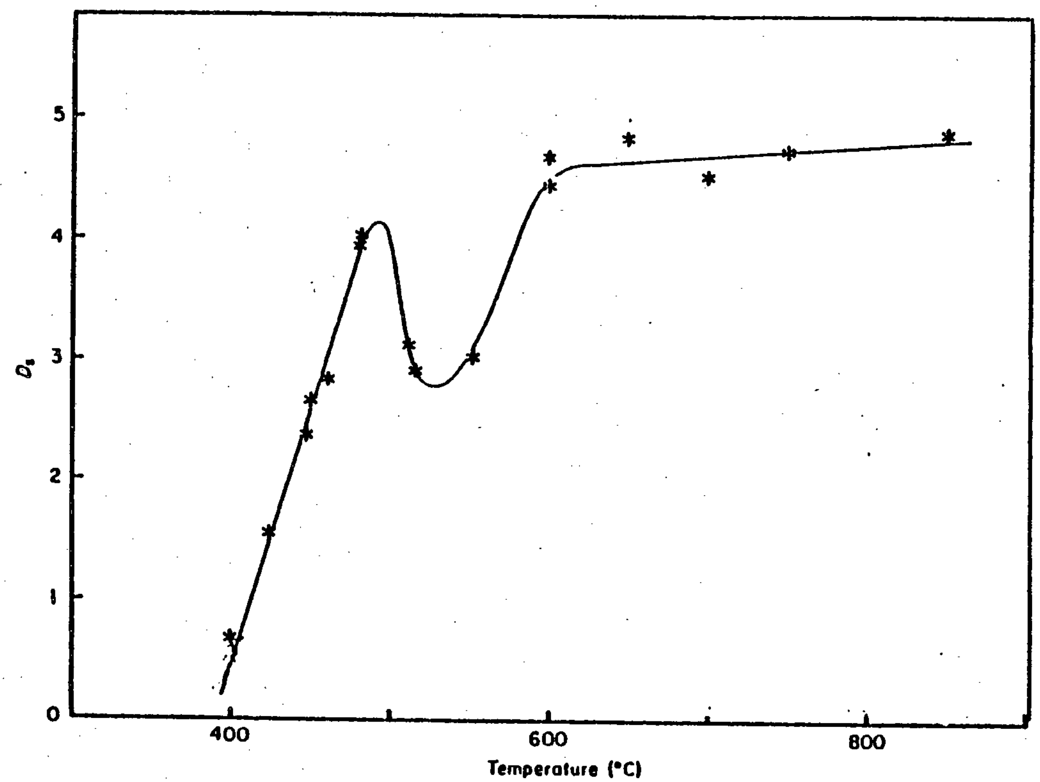


FIGURE 2.18: Specific optical density vs combustion temperature for PVC.

tested in the above work, although it seems that the temperatures have an important role in deciding the amount of the smoke measured.

(d) Radiant heat flux

Different heat flux radiation facing the sample means different surface temperature, hence different rate of burning. Different levels of heat flux are specified with different standards: 3.5 - 6.0 W/cm^2 in the tunnel test, 2.5 W/cm^2 in the NBS test and 1.0 - 5.0 W/cm^2 in the ISO test. Even with the constant heat flux level in NBS, it is difficult to achieve a uniform flux over the entire surface of the sample. Breden and Meisters (1976) found that a much lower heat flux was measured at the edges than at the centre of the sample (Figure 2.19).

FIGURE 2.19: Vertical flux distribution, W/cm^2.

			2.33			
			2.30			
2.08	2.34	2.55	2.62	2.58	2.40	2.14
			2.45			
			2.16			

←——— 6.4 cm ———→

Phillips (1976) studied the same behaviour as well (Figure 2.19) (the radiant flux was 100 mm in front of the face of the element). This shows that for a nominal flux of 2.5 W/cm^2 (i.e. 2.5 W/cm^2 on the centre line of the element), the actual flux over the exposed area is between 2.38 and 2.5 W/cm^2. Another factor affecting the measurement of radiation level is that as the material burns or shrinks, the distance between the surface of the sample and the heater will increase. Christian (1984) studied this effect and his results are presented in Table 2.16.

TABLE 2.16: Heat flux measurements.

Distance from surface of sample (mm)	Heat flux at receiver surface (W/cm^2)
2.0	2.5
5.0	2.25
12.5	1.95
25.0[1]	1.55

[1]maximum thickness of sample in NBS

A lot of work has been done to study the effect of changing the radiation level. A few examples are chosen here to study and compare with each other. The results obtained by King (1975) for five materials (rigid PVC, plasticized PVC, ABS, polystyrene and Red oak) tested in the NBS chamber with flaming combustion and different heat flux levels are shown in Figure 2.20 and Table 2.17. The plastic showed strong dependence on the heat flux, with the highest D_S recorded at 2-3 W/cm^2. Variation of heat flux had little effect on the Red oak. King reported the weight loss, so it has been possible to calculate the smoke potential (D_o) for the five materials, the results of which are presented in Table 2.17.

TABLE 2.17: Variation of smoke potential with heat flux radiation (flaming) (King, 1975).

	Materials:									
	Rigid PVC		Plasticized PVC		ABS		Polystyrene		Red oak	
Heat flux (W/cm^2)	D_s	D_o	D_s	D_o	D_s	D_o	D_s	D_o	D_s	D_o
1.0	80	1.30	220	3.13	180	2.46	125	2.93	20	0.29
1.9	140	2.18	288	3.45	315	3.97	170	2.70	25	0.31
3.1	310	3.97	345	4.14	415	4.12	280	3.16	27	0.32
4.2	378	4.12	400	4.50	377	3.99	370	3.33	22	0.31
Ratio of values at 4.2 and 1.0 W/cm^2	4.37	3.17	1.82	1.42	2.09	1.62	2.96	1.14	1.10	1.07

D_o = ob.m^3/gm

D_s = bel.

The heat flux seems to have no effect on the Red oak, but the biggest effect is on the rigid PVC, as both D_S and D_O increased sharply when the flux radiation increased from 1.0 to 4.2 W/cm². In general, both D_S and D_O increased with increasing the heat flux.

Work by Chein and Seader (1974) has the same trend as with the results from King. They modified the NBS chamber by introducing a heater capable of providing a heat flux of up to 8 W/cm². Three materials have been tested (under non-flaming), α-cellulose, Douglas fir and a flexible polyurethane foam based on TDI. The results showed that with increasing the heat flux radiation, the specific optical density increased for the three materials. For α-cellulose and wood, the D_S sharply reduced when the material auto-ignited at a high level of heat flux.

Edgerley and Pettett (1980) tested a variety of materials (under non-flaming conditions) using the NBS chamber, and their results are given in Table 2.18. Their findings for D_S agreed with those findings of King and Chein and Seader.

As a general rule, as the heat flux was increased, the specific optical density increased up to the point of auto-ignition, which converted the mode of combustion to flaming at which almost all the materials give less smoke.

2.4 Conclusions

The question of whether or not it is possible to predict how much smoke will be released during the burning of a particular combustible material must be answered. The problem of smoke testing is not simple, as the yield of smoke depends in a complex way on many variables. Malhotra *et al*. (1982) recommended the use of a test which is able to establish both dynamic production and the accumulation of smoke production with accumulative system. Another question to be asked here,

TABLE 2.18: Specific optical densities at various radiant heat fluxes (non-flaming).

Material	Thickness (mm)	Heat flux (W/cm^2) 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Polyethylene (LD)	2.0	30	128	349	414	432	41[1]	75[1]	74[1]	107[1]
Polypropylene	2.0	106	317	452	555	565	623	681	695	701
Polystyrene	2.0	63	228	323	418	457	570	641	713	837[1]
Poly(methylmethacrylate)	2.5	0	18	96[1]	122[1]	130[1]	144[1]	141[1]	128[1]	144[1]
Poly(ethylene terephthalate)	0.5	0	0	0	38	71	130	202	305	304
Polyurethane (rigid foam)	9.0	81	239	448	426	564	415[1]	648[1]	770[1]	~964[1]
Poly(vinylchloride)	1.6	0	69	161	306	388	497	598	749	844
Polycarbonate	3.2	0	7	30	41	111	173	371	826[1]	~964[1]
FR Polyethylene (LD)	2.0	27	64	321	441	652	426[1]	549[1]	582[1]	666[1]
Fir	3.2	9	75	358	484	520	547	553	34[1]	28[1]
Mahogany	3.2	5	114	276	452	618	556	654	55[1]	62[1]
Oak	3.2	11	116	298	463	617	693	781	13[1]	12[1]
α-Cellulose	0.8	18	171	202	213	227	236	13[1]	8[1]	7[1]
Hardboard	4.8	229	529	648	713	769	81[1]	79[1]	83[1]	100[1]
Natural rubber[2]	2.0	64	546	436[1]	593[1]	667[1]	766[1]	851[1]	~964[1]	~964[1]
Leather	1.0	12	26	35	47	68	69	134	145	8[1]

[1] flaming mode; [2] black-filled, cured

is whether the test method can be used as for the material selection? The answer may be that use of these tests as a guide is more acceptable. As the same material gave different smoke yields under different conditions, even a very small variation in heat flux can change the ranking of the materials tested.

Two series of tests were developed to study the smoke production from combustible materials. The first involved the following small scale test methods:

(a) The standard NBS chamber test (ASTM, 1979)

(b) Edinburgh University chamber test (Phillips, 1976)

(c) Arapahoe chamber test (ASTM 1981)

The second series involved the model compartment which will be discussed in Section 3.2.

3.1 Small Scale Laboratory Tests

3.1.1 NBS chamber test

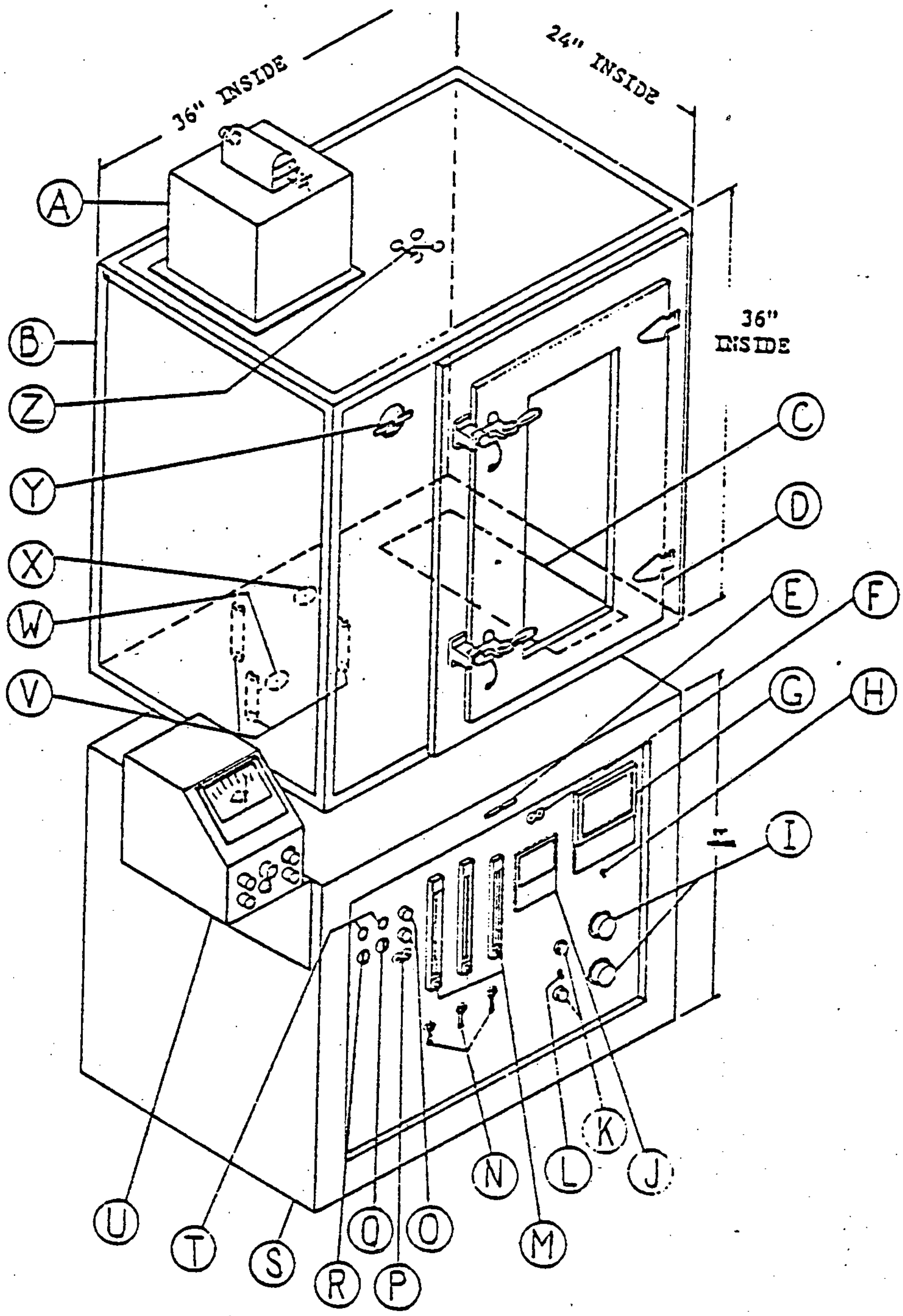
The test chamber is constructed from laminated panels with internal dimensions of 914 x 610 x 914 mm high (Figure 3.1). This chamber contains the following.

3.1.1.1 Radiant heat furnace (Figure 3.2)

An electric radiant heater, 76 mm in diameter, was used to provide a constant radiant heat flux on the specimen surface and was located centrally on the long axis of the chamber. It was controlled by an autotransformer to maintain the required steady flux during the test. To standardise the output of the radiant heat furnace, a circular foil type stainless steel reflective heat shield with a 38 mm aperture on the front and cooler supplied with compressed air mounted on the rear (Figure 3.2) was used to maintain a constant body temperature of 93 ± 3°C.

3.1.1.2 The specimen holder (Figure 3.3)

The specimen holder was designed to expose 65 x 65 mm area of the sample surface. A square piece of asbestos 76 x 76 mm was used

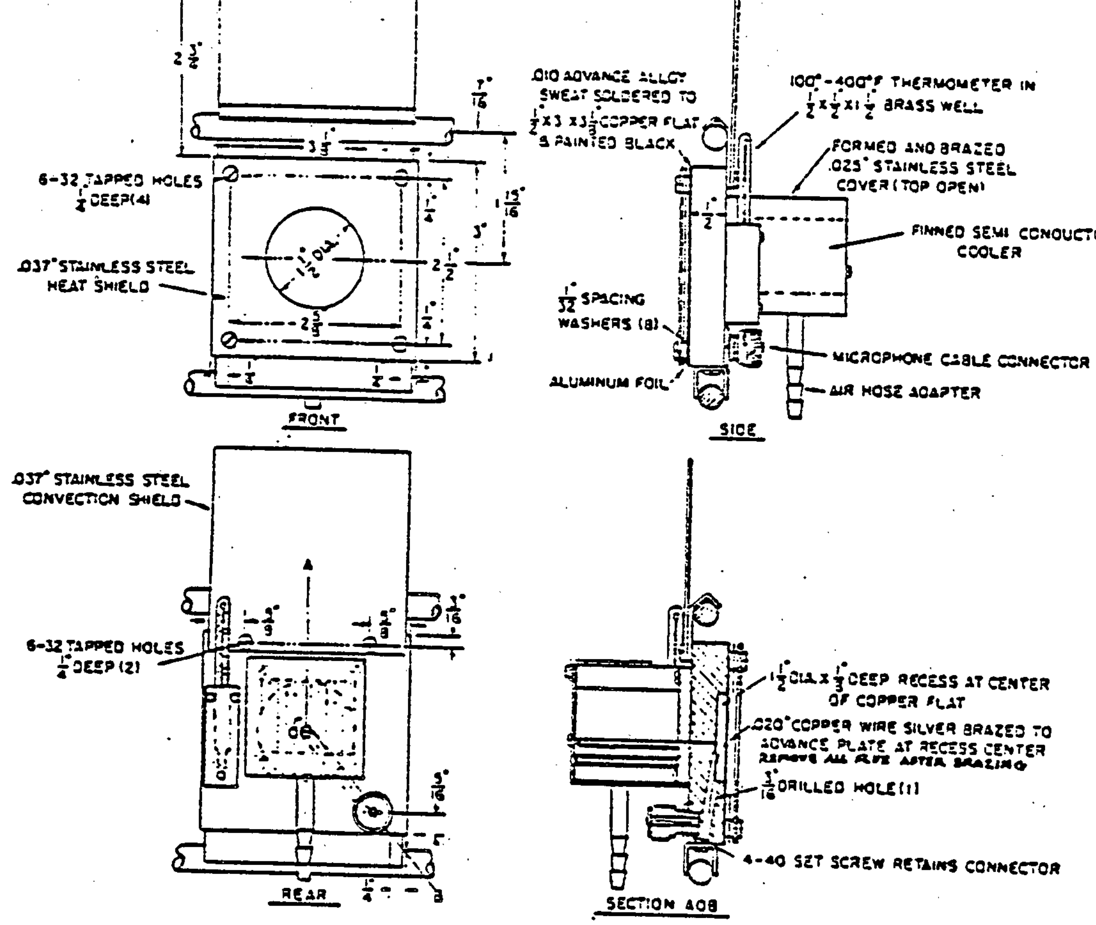


A - Phototube Enclosure
B - Chamber
C - Blowout Panel
D - Hinged Door with Window
E - Exhaust Vent Control
F - Radiometer Output Jack
G - Temperature (Wall) Indicator
H - Temperature Indicator Switch
I - Autotransformers

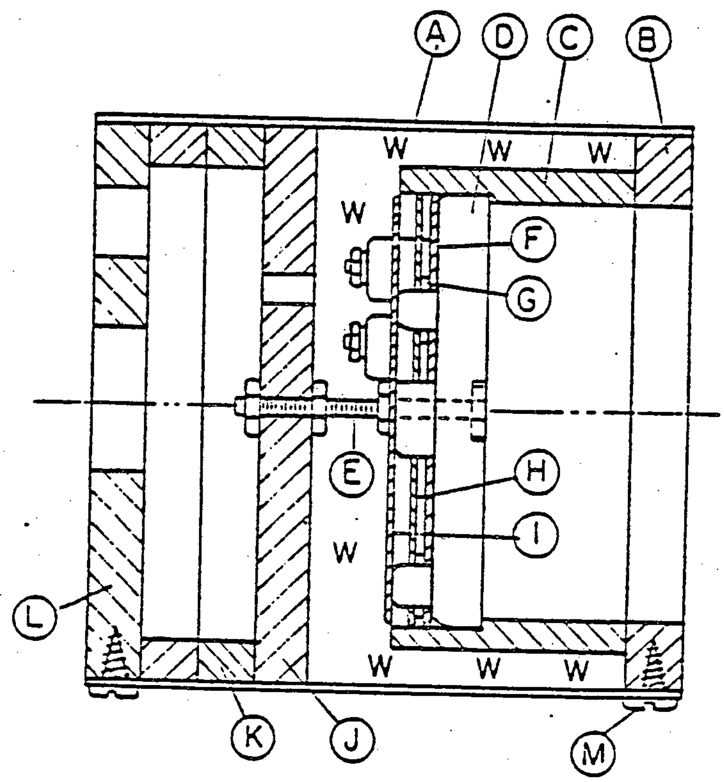
J - Voltmeter (furnace)
K - Fuse Holders
L - Furnace Heater Switch
M - Gas & Air Flowmeters
N - Gas & Air Shutoff Valves
O - Light Intensity Controls
P - Light Voltage Measuring Jack
Q - Light Source Switch
R - Line Switch

S - Support Frame
T - Indicating Lamps
U - Photometer Readout
V - Rods
W - Glass Window
X - Exhaust Vent
Y - Inlet Vent
Z - Access Ports

FIGURE 3.1: NBS chamber (ASTM E662).



(a)



(b)

- STAINLESS STEEL TUBE
- ASBESTOS BOARD
- CERAMIC TUBE
- HEATING ELEMENT, 525 W
- STAINLESS STEEL SCREW

F - ASBESTOS PAPER GASKET
G - STAINLESS STEEL SPACING WASHERS (3)
H - STAINLESS STEEL REFLECTOR
I - STAINLESS STEEL REFLECTOR

J - ASBESTOS BOARD
K-ASBESTOS BOARD RINGS
L-ASBESTOS BOARD COVER
M-SHEET METAL SCREWS
W-PYREX GLASS WOOL

FIGURE 3.2: Radiant heat furnace.
(a) radiometer details; (b) furnace section (ASTM E662).

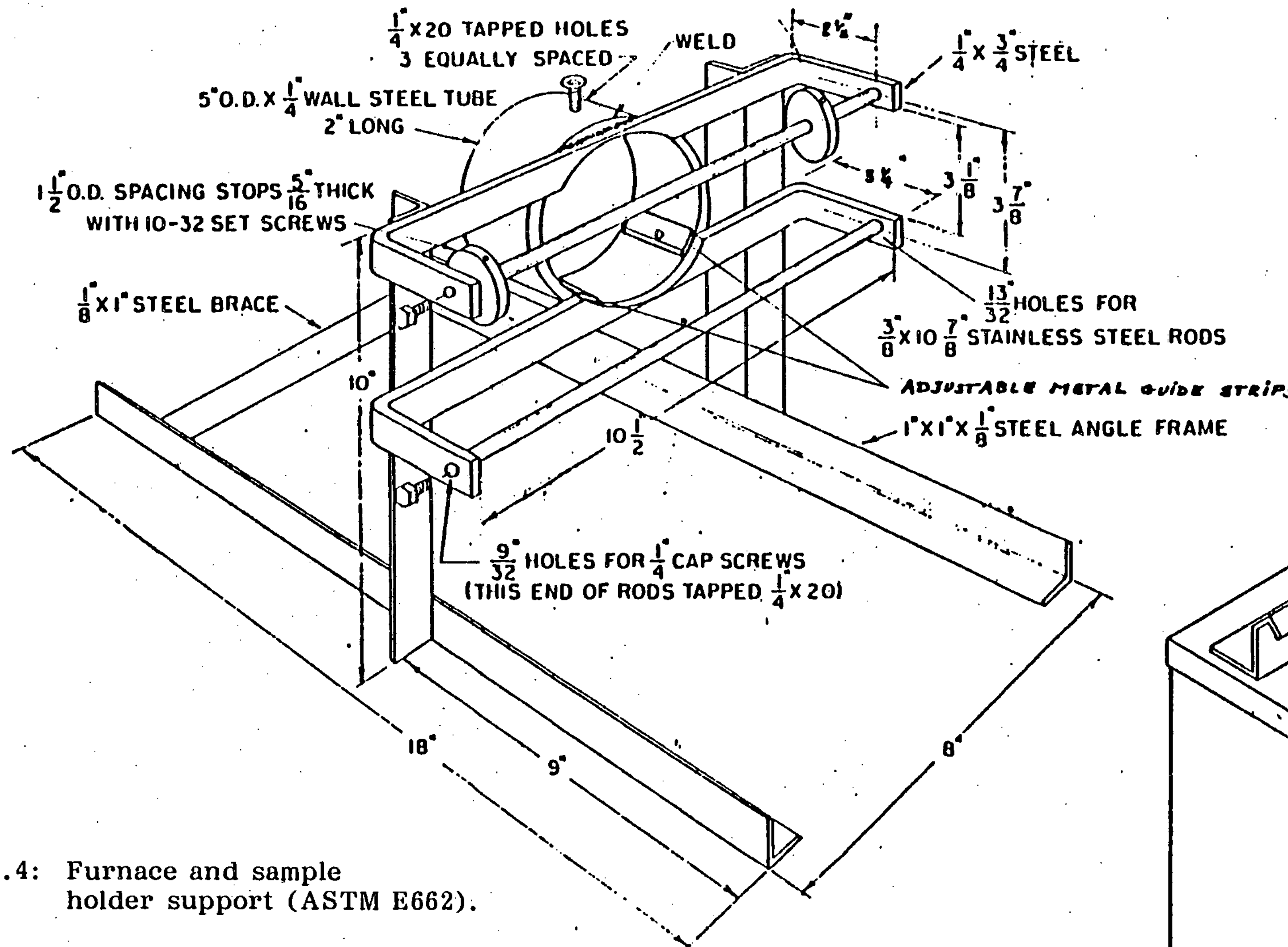


FIGURE 3.4: Furnace and sample holder support (ASTM E662).

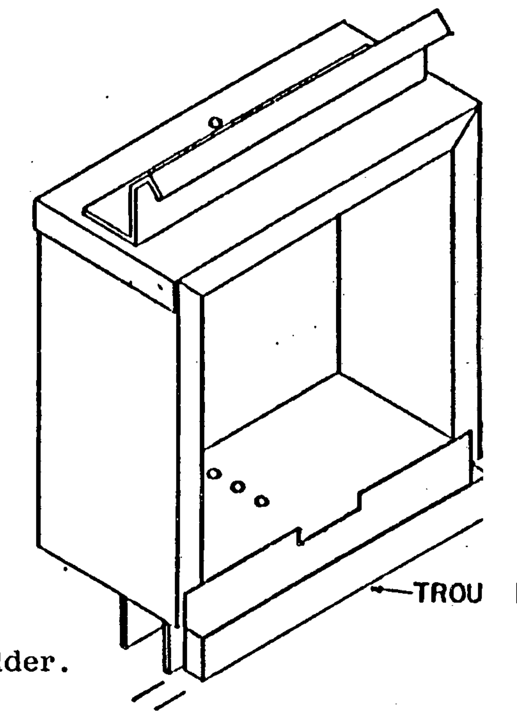


FIGURE 3.3: Sample holder.

to back the sample inside the holder, both being retained by a spring and rod. The radiant element and the sample holder were supported inside the chamber (Figure 3.4).

3.1.1.3 The photometric system (Figure 3.5)

This consists of two main components, the light source and the photo-electric cell, with the light beam oriented vertically to avoid the effect of stratification within the chamber during test.

(a) The light source was an incandescent lamp operated at a fixed voltage in a circuit powered by a voltage regulator.

(b) The photo-electric cell was a multiplier tube, and a dark current less than 10^{-9} A. The photocell and focussing optics were housed in a sealed box which was located directly opposite the light source, as shown in Figure 3.5.

3.1.1.4 The Manometer

For the chamber pressure measurement, a water manometer with a range up to 150 mm of water was used to monitor chamber pressure and leakage.

3.1.1.5 The burner

For flaming combustion, the sample was exposed to six small pre-mixed propane/air flame from a multiple burner (Figure 3.6). This consisted of six multidirection jets arranged in pairs and was located symmetrically in front of the specimen holder with the line of jets parallel to the sample. The tips of the two horizontal tubes were located 6.4 mm above the holder edge and 6.4 mm from the specimen surface. Two rotameters were used for metering the gases (500 cm^3/min of air and 50 cm^3/min of propane).

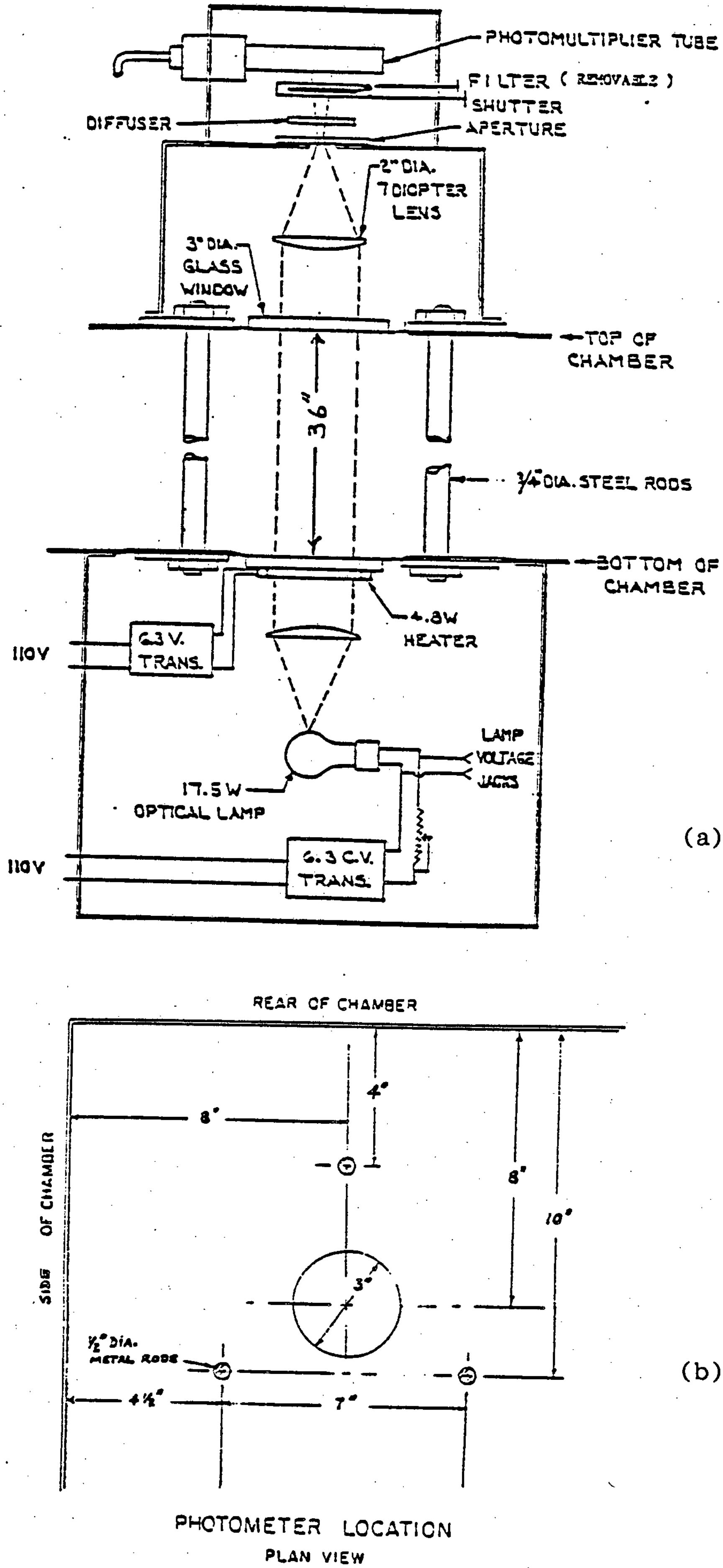


FIGURE 3.5: The photometric system.
(a) details; (b) location (ASTM E662).

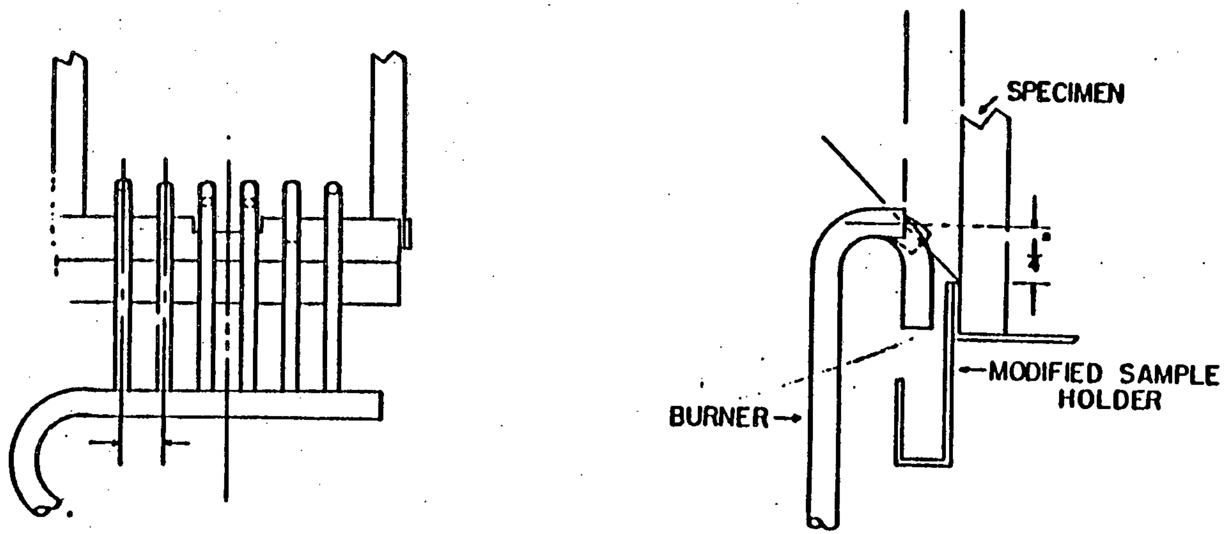


FIGURE 3.6: The burner (Breden *et al.*, 1976).

3.1.2 *Edinburgh University Chamber (EU)*

The tests were carried out in the Fire Safety Engineering Laboratory. It involved burning a 76 x 76 mm square sample in a radiant furnace located in a 13.75 m^3 smoke chamber (Figure 3.7). The smoke produced was allowed to accumulate inside the chamber and its opacity was measured by a vertical photodetection system, similar to that used in the NBS chamber test (Para 3.1.1.3), but with a path length of 2.2 m. The radiant furnace (Figure 3.8) was based on that developed by Gross *et.al.* (1967) for the original NBS chamber test (Phillips, 1976). The heat flux at the sample surface was determined by using a radiometer (Figure 3.9) which had been calibrated against a standard. A variable transformer (type Regulac RK15-M) was used to adjust the output from the radiant heater to the sample surface. The radiometer and the sample holder were mounted side by side on a sliding plate which could be moved to bring either the radiometer or the sample directly in front of the heater. The sample was exposed through an open area in the sliding plate which allowed 65 mm x 65 mm of its surface to be exposed to the heater (Figure 3.10). For flaming combustion, a burner was used which consisted of six small parallel jets directed horizontally at the sample surface. The flame length was adjusted to 13 mm, and the tips of the jets were located 25 mm below the horizontal centre line and 6 mm in front of the sample surface.

3.1.3 *Arapahoe Chamber test (ASTM 1981)*

The Arapahoe test is a gravimetric method. The sample (38 x 12 x 3 mm) to be tested was held in a flame for 30 seconds in a stream of air which was drawn through a glass microfibre filter to collect the smoke. The system which is shown in Figure 3.11, consisted of a vertical, cylindrical combustion chamber 125 mm in diameter and 175 mm high with

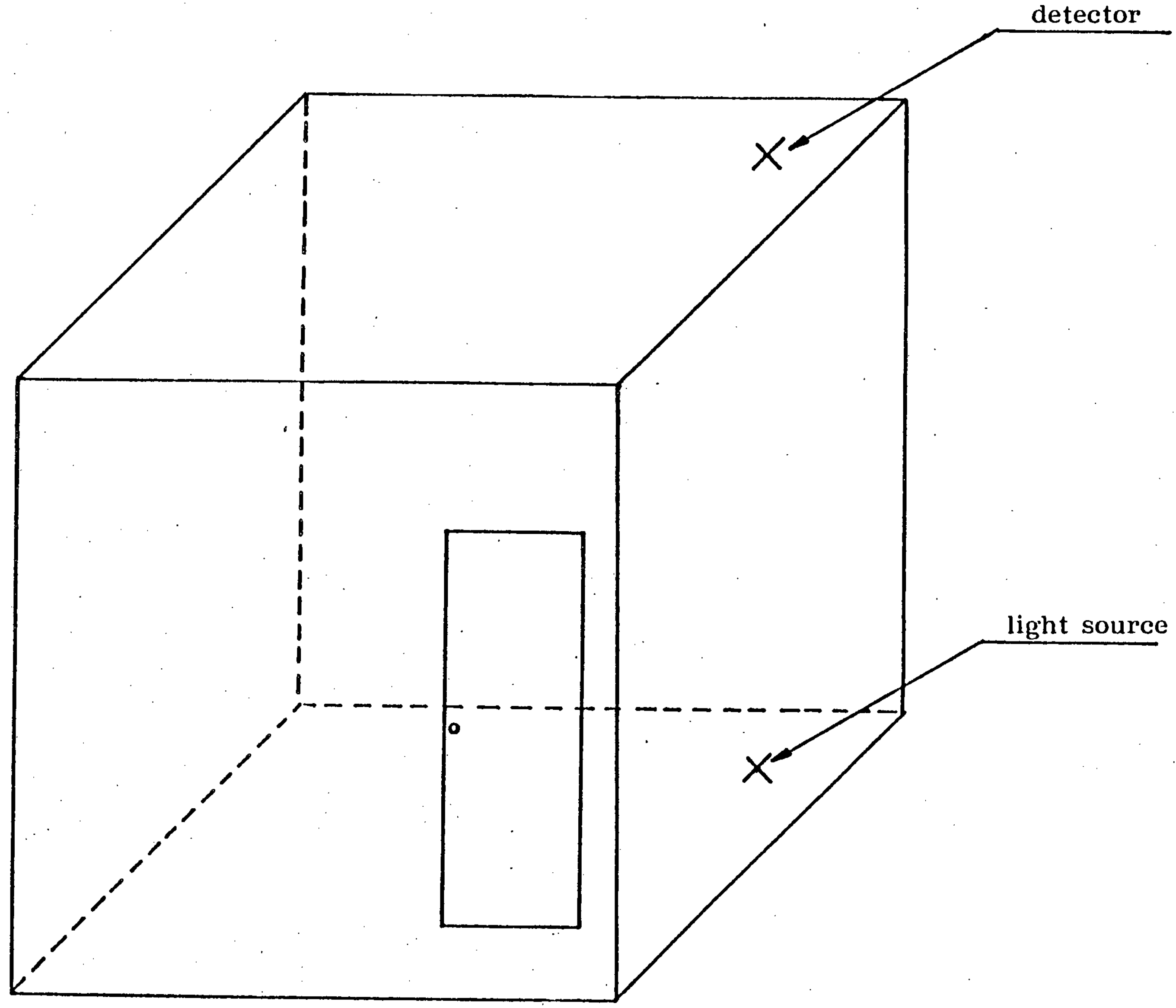


FIGURE 3.7: Edinburgh University chamber.

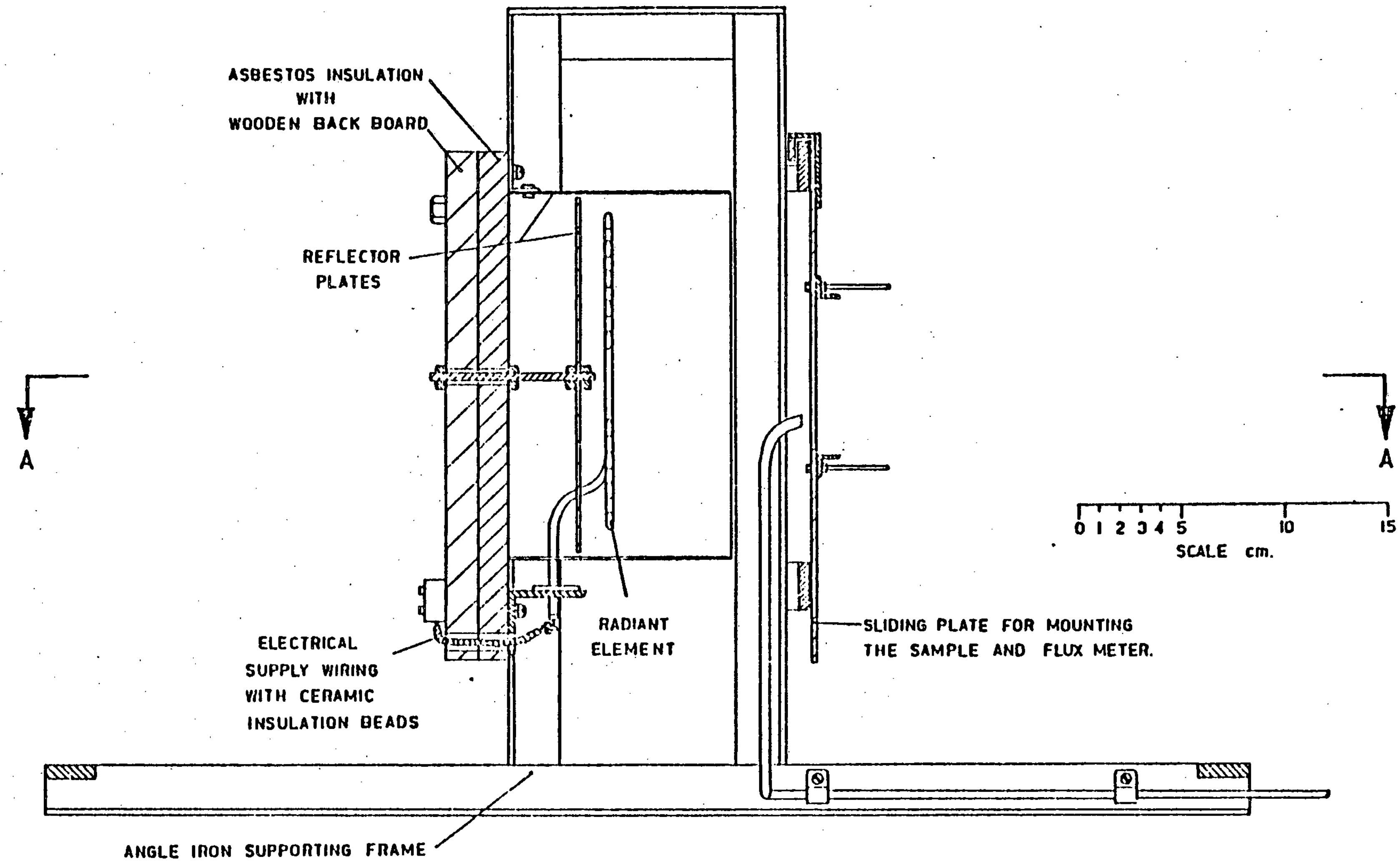


FIGURE 3.8: Smoke generating furnace (Phillips, 1976).

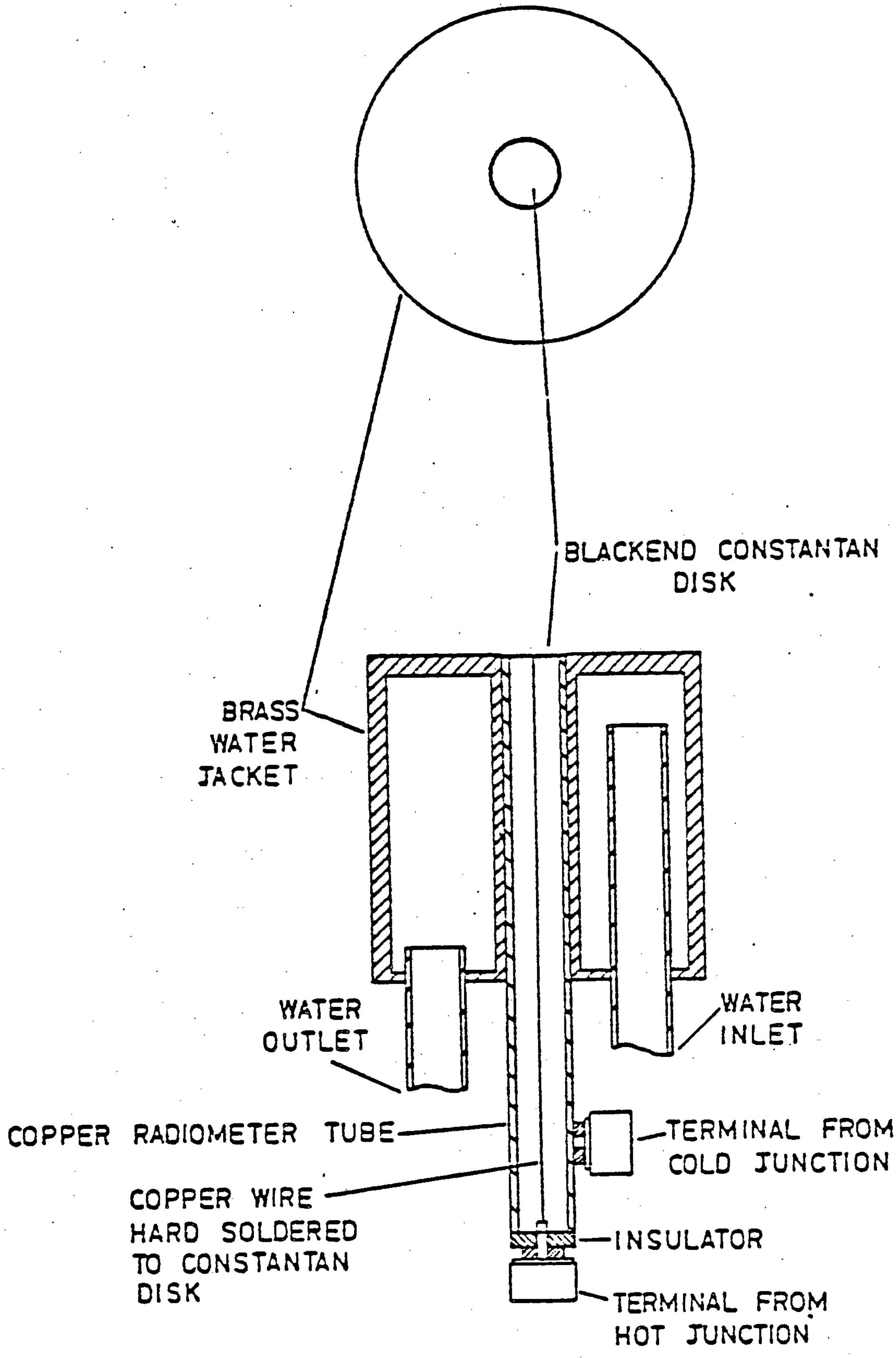


FIGURE 3.9: The radiometer.

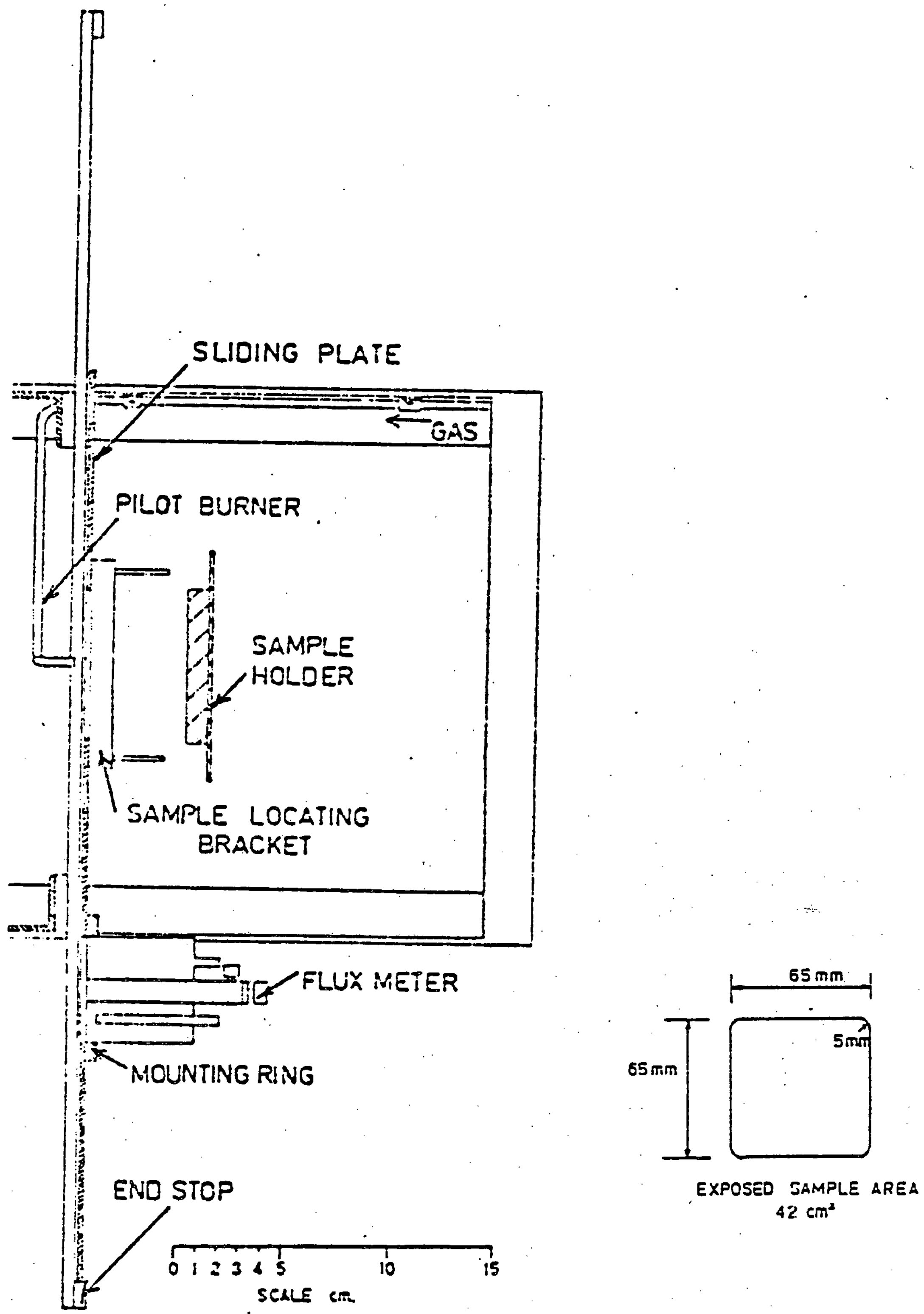


FIGURE 3.10: Sample holder.

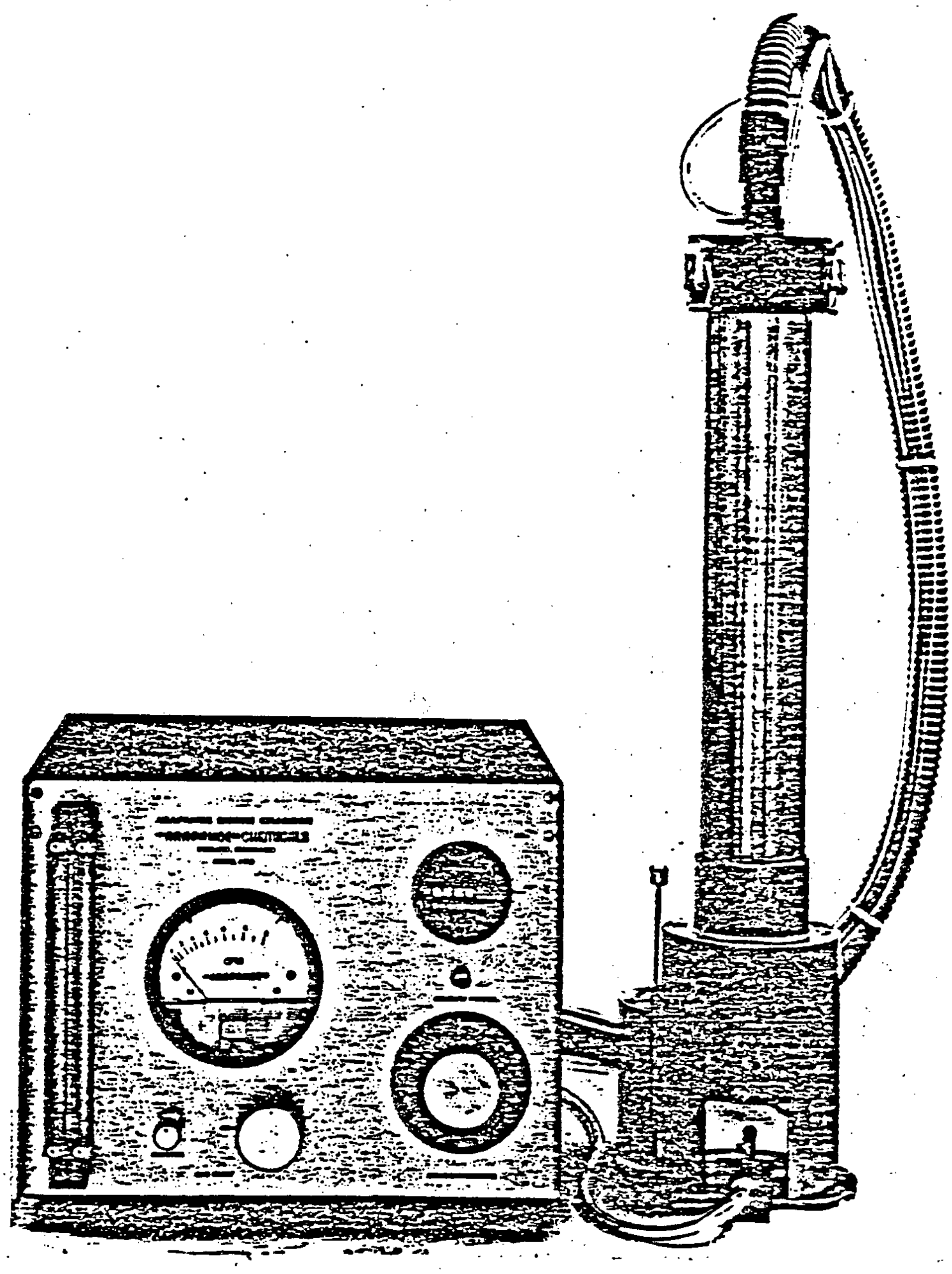


FIGURE 3.11: Arapahoe chamber.

a door and a chimney (457 mm height and 76 mm diameter). The filter holder 90 mm in diameter was located at the top of the chimney. To make the specimen move into a fixed position when the door was closed, the specimen holder was attached to the inside of the door of the combustion chamber. A microburner mounted at an angle of 10° from the horizontal, was located in the base of the combustion chamber and was supplied by a controlled flow of propane. The air flow through the filter was controlled by instrumentation housed in a separate cabinet. This included a timer which was actuated by closing the door of the combustion chamber. To enable accurate determination of the weight of char and burnt material at the end of a test, a sandmill was used to clean the char from the burned sample (Figure 3.12). An electrical balance with sensitivity of 1 μg was used for weighing the sample and the filter paper before and after the test.

The samples for the above tests were prepared and stored for the purpose of the test under the ambient conditions.

3.2 The Model Compartment Series

3.2.1 Construction

Most of this series was carried out at the Scottish Fire Service Training School at Gullane, in a chamber of 240 m^3 total volume, maximum dimension 10.2 x 8.15 x 3.0 m height (Figure 3.13). The chamber had a false ceiling to protect the underside of the proper ceiling from the large fires normally burnt as a source of smoke and heat for training purposes. Ceiling panels near the corners were removed to allow the optical beams to pass from the ceiling to the floor. The small scale "room-corridor assembly" is shown in Figure 3.14. It was designed to enable the fire box (the model compartment) to be weighed continuously while the flow of air and combustion products passed through a square duct (the corridor).

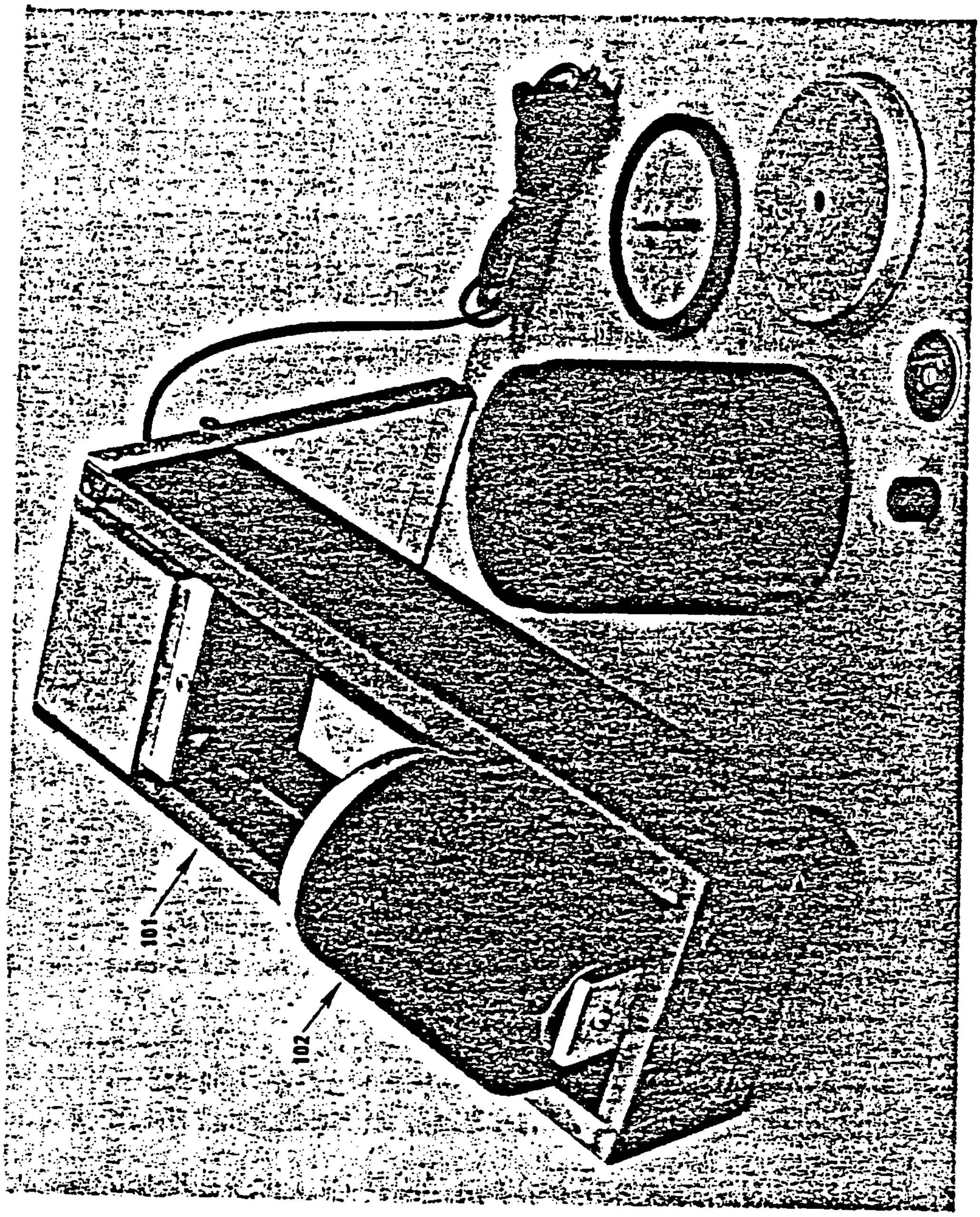


FIGURE 3.12: The sandmill.

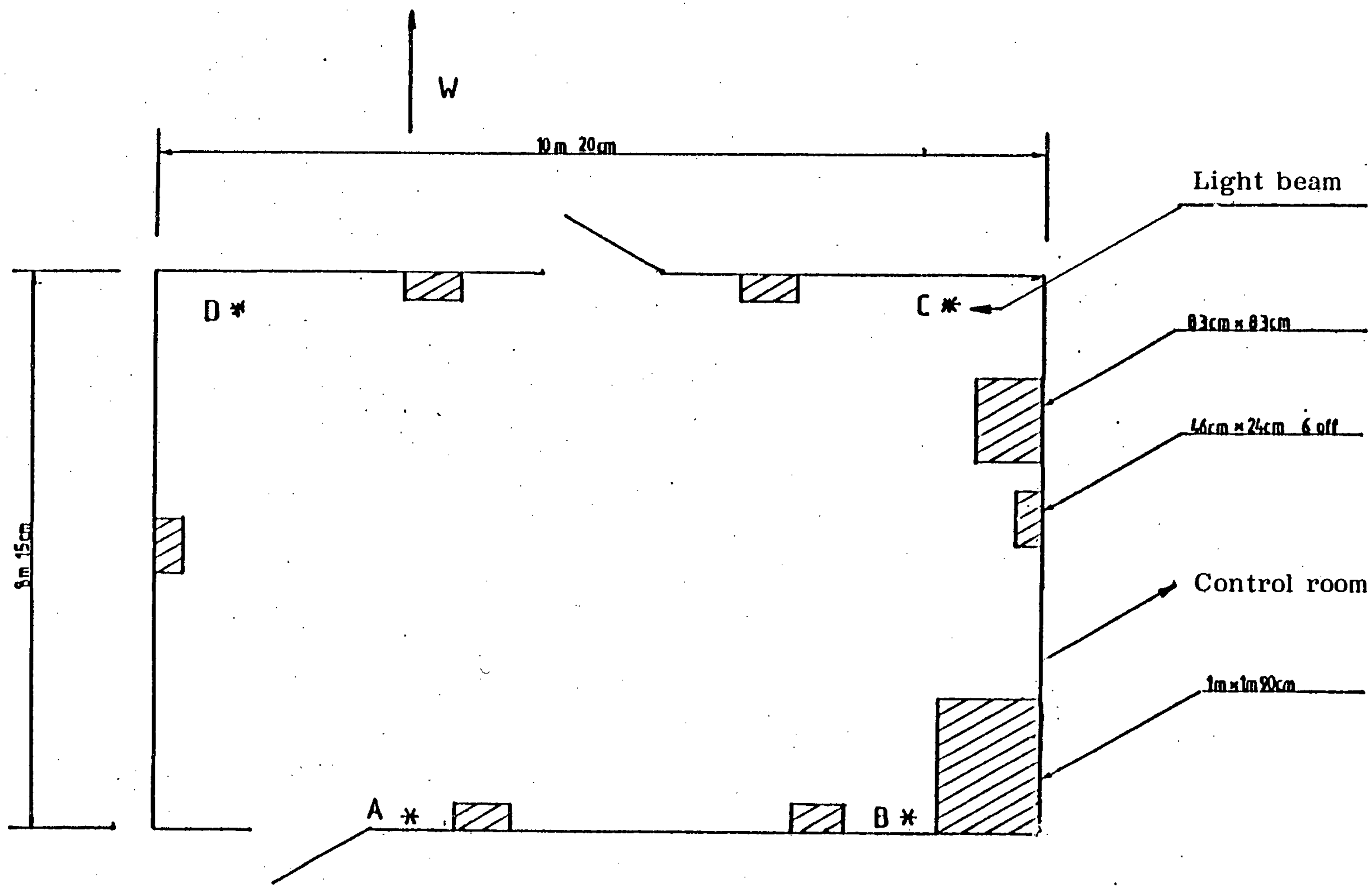


FIGURE 3.13: Test room (Gullane).

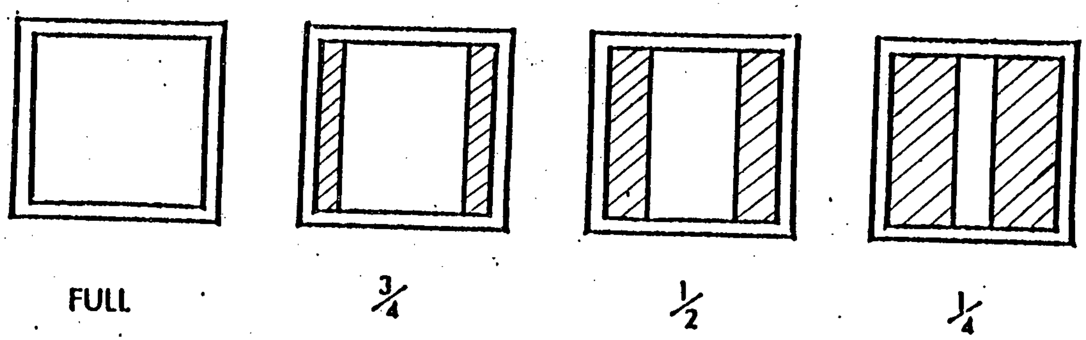


FIGURE 3.15: Ventilation opening.

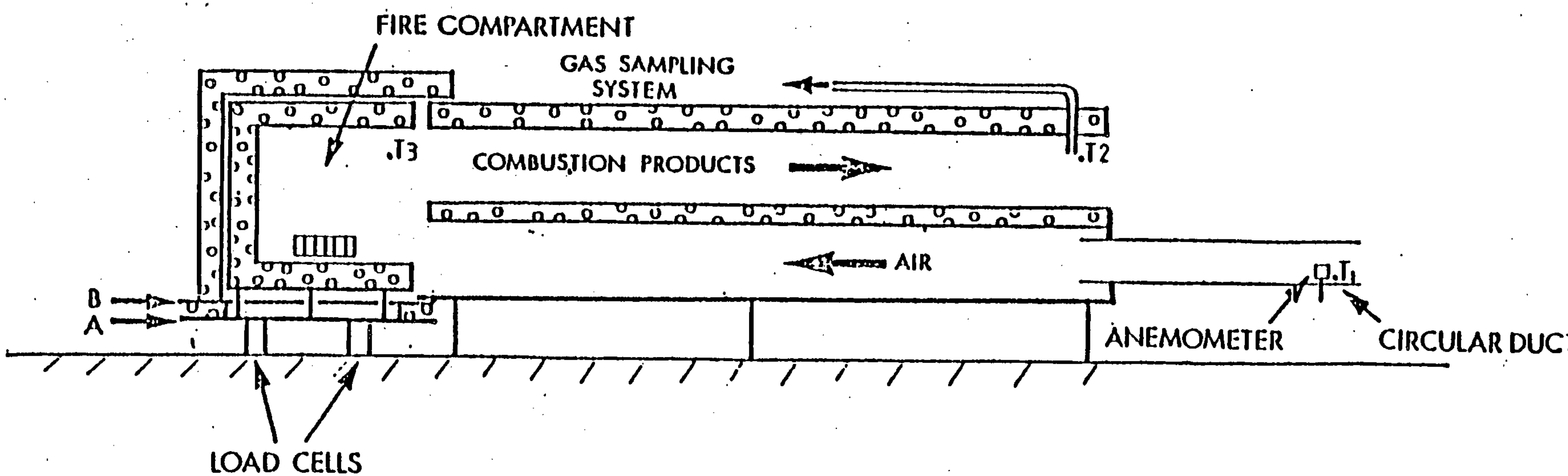


FIGURE 3.14: Room corridor assembly.

The assembly was constructed from angle iron with panels of Supalux lined with a ceramic fibrebaord (Kaoboard). The cubical fire box had external and internal dimensions of 0.5 m and 0.4 m respectively: one side was open and could be fitted with Kaoboard panels to reduce the opening from 0.4 m (full width) down to 0.1 m, as shown in Figure 3.15. The box rested on a wooden platform 0.5 x 0.5 m, which in turn was supported on five vertical posts (40 mm high and 12 mm diameter rods), fixed to a lower platform (A) which rested directly on two 25 kg capacity load cells. A third platform (B) lying between the latter pair, had holes drilled to allow independent movement of the fire box/load cell assembly (Figure 3.14). This platform was fixed with supports resting on the ground and was used when necessary to support an outer enclosure which provided a seal between the fire box and the model corridor. The end of the corridor fitted inside the opening of the outer enclosure and the gap sealed by packing with mineral wool. In this way the "room and the corridor" were almost continuous yet the corridor did not interfere with the weight loss measurement. The loss of combustion products into the space between the fire box and the outer enclosure was assumed to be negligible, although there was no way of quantifying this. A deposit of soot accumulated on top of the box during a series of tests.

The corridor which had a cross section of 0.5 x 0.5 m was divided into lower and upper sections, the latter being lined with Kaoboard giving inner dimensions of 0.4 m wide by 0.2 m high. This arrangement separated the inflow of air from the outflow of combustion products, thus preventing mixing which could stimulate flaming in the corridor under conditions of poor ventilation, e.g. one-quarter opening (Ames and Fardell, 1980). The air inflow to the fire was determined by means of a vane anemometer (para 3.2.2.4) located within a circular duct attached to the end of the lower section of the corridor, as illustrated in Figure 3.14.

This was effectively the only means by which air could enter the fire box as the other opening was sealed. The corridor was made in two sections, each 1 m long, and rested on an angle iron frame whose height enabled the height of the fire box to be matched. A 2 m extension to the upper part of the corridor was constructed to enable the effect of corridor length on D_o (Dynamic) to be examined in more detail. Temperatures were measured by thermocouples located at the anemometer (T_1) (ambient temperature), at the end of the corridor, in the outflowing gases (T_2), and 15 mm under the celing of the fire box (T_3).

A small stream of combustion products was withdrawn continuously from the end of the corridor through a 6 mm diameter sampling line, incorporating a filter and drying tube, by means of a diaphragm pump (para 3.2.2.3). The CO, CO_2 and O_2 content of the gases was monitored continuously using commercial analysis units (para 3.2.2.3). The opacity of the smoke flowing from the end of the corridor was determined when possible by a diagonal light beam/photo cell arrangement similar to that used by Woolley *et al.* (1979-80) (Figure 3.16).

Lateral spread of the plume was restricted by two Supalux boards placed so as to maintain the plume width at the height at which the measurement was being made. The depth of the smoke layer was established first by observation and then by limiting the opening roughly to this depth with a single thickness of "clingwrap" (thin polyethene sheet used to wrap food). This material softens and sags at temperatures between 100-150°C and will increase the depth of the opening when and as necessary. The depth can be measured at the end of each test. In the early tests only static measurements were made, with four vertical optical beams located near the corners of the chamber to enable an average smoke density to be calculated and any effect of ambient wind conditions on the

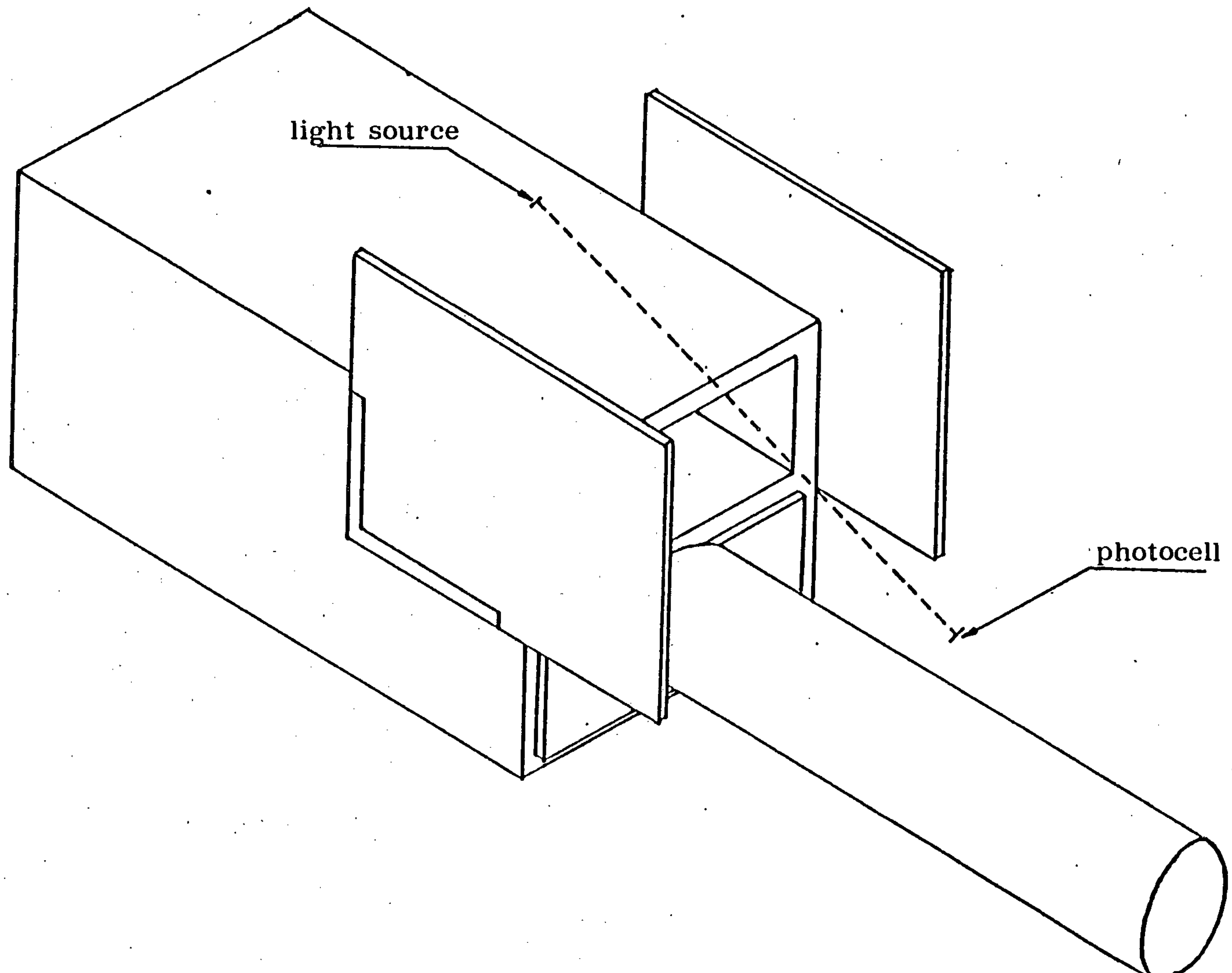


FIGURE 3.16: Light beam for dynamic measurement.

uniformity of smoke distribution to be assessed (Figure 3.13). A number of tests were carried out with one diagonal and three vertical beams so that measurement of D_o (static) and D_o (dynamic) could be made at the same time. Dynamic measurements only were made in the fire safety engineering laboratory with corridor length of 4 m.

Up to thirteen channels of data were logged (Table 3.1) at 5 second intervals using a data acquisition system supplied by Datron Ltd (para 3.2.2.7) and which was based on that developed for the Fire Research Station. The software was modified to suit the requirements of this project.

TABLE 3.1: Details of the data channels.

Channel No.	Device	Measurement
1-3	Thermocouples (Chromel/Alumel)	Temperature
4	Anemometer (Edra 5, Airflow Development Ltd, UK)	Air flow
5	Heat flux meter	Radiant flux
6	Gas analyser (SS100, Analytical Development Co. Ltd)	CO_2
7	Gas analyser (SS200, Analytical Development Co. Ltd)	CO
8	Gas analyser (Servomex OA.570, Sybron-Taylor)	O_2
9	Load cell (Stainstall Ltd)	Weight loss
10-13	Photocell (ORP12: Cadmium sulphide light dependent resistor)	Obscuration

3.2.2 *Instrumentation*

3.2.2.1 *The load cell*

Two load cells have been used - type 1213/B, Stainstall Ltd - with the following specification:

Rating 25 kg

Supply voltage - normal 10 V, maximum 25 V.

3.2.2.2 The radiometer

To measure the radiation from the fire, a radiometer was used for this purpose (Figure 3.8). It was 100 mm away and in front of the fire box or of the corridor, and 150 mm below the level of the ceiling.

3.2.2.3 Gas analysis system

The gas analysis system is illustrated in Figure 3.17. The sample line was a PVC tube of 5 m length with two filters, the first being glass wool filter to remove smoke particles, while the second was a drying tube containing granular calcium chloride. One end was connected to 1.4 m copper tube which was bent through 90° at one end to fit through a hole to the roof of the corridor, while the other end was connected to the pump. The latter was a diaphragm pump (type Capex 2D) of capacity 6 l/min. It provided a continuous flow of combustion products to a manifold from which the three analysis units, each with its own pump, withdrew the required flows of gas. Excess gas was expelled to the atmosphere.

The analysers used for CO and CO_2 were NDIR absorption analysers, type SS200 and SS100, respectively, with a range of 0-20%. Their sensitivity to the other expected products in the fire, are presented in Table 3.2 (overleaf). This table shows that with an average of 10% CO_2 in the smoke, the effect on the CO analysis would be negligible. The same is true for the effect of CO on CO_2 analysis. As the gases are first passed through a drying tube, the effect of water vapour on both CO and CO_2 measurement will also be negligible.

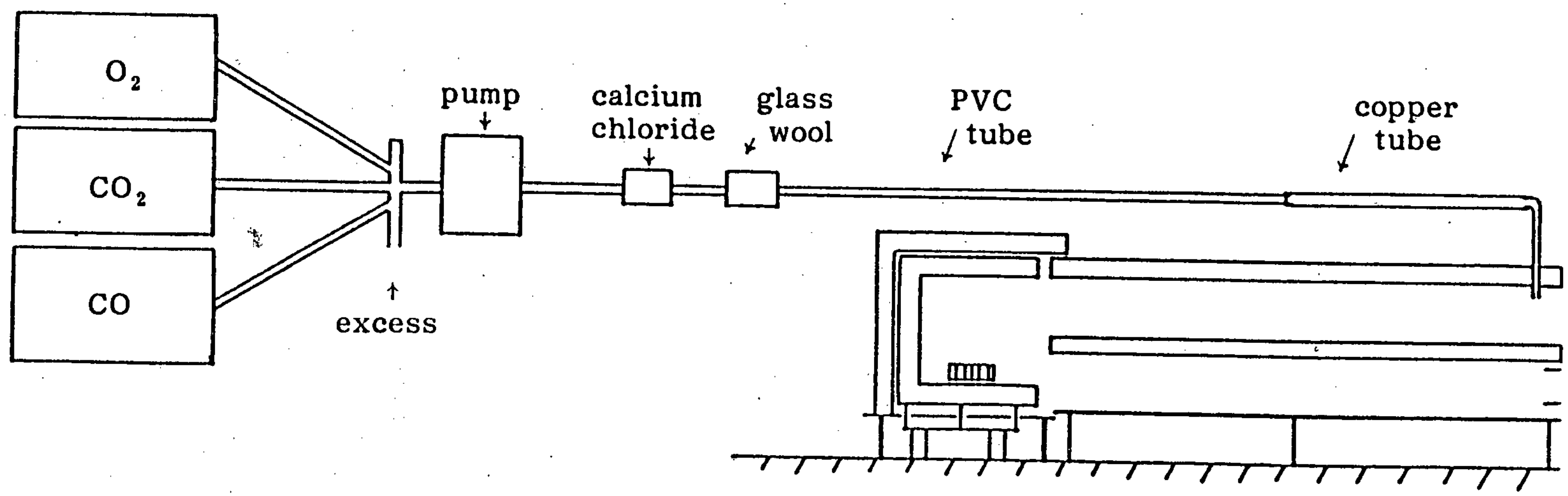


FIGURE 3.17: Gases system.

TABLE 3.2: Sensitivity of CO and CO_2 analysers to other products.

Analyser	% Impurity	% Maximum reading of the gas
Carbon monoxide	2% water	0.02
	100% CO_2	0.12
Carbon dioxide	2% water	0.02
	100% CO	0.02

The oxygen analyser used is type Servomex OA250 which relies on the paramagnetic properties of oxygen to determine its concentration. The sensitivity of the analyser to other materials, assuming that it is calibrated such that nitrogen = zero, and oxygen = 100, and then used with other oxygen-free gases, is listed below:

Gas or vapour	% Reading
CO_2	-0.27
CO	+0.01
water	-0.02

This means, as in CO and CO_2 analysers, the presence of these gases will produce a negligible effect on the results well within the limit of accuracy of these experiments. The three analysers gave an output voltage which was calibrated against samples of known composition.

3.2.2.4 The Anemometer

An electric analog-Vane anemometer, type EDRA5, was used with a measuring range of 0.25 to 5 m/sec and an accuracy of ±5 to 10% according to the velocity (Figure 3.14). Its output voltage was calibrated by using an ordinary fan with different speeds.

3.2.2.5 The photometric system

The opacity of the smoke was measured with equipment identical to that described in paragraph 3.1.1.3. Four independent light beams were used. The path length of the vertical beams was ~3.0 m, the photoelectrical cell was a few centimetres from the floor while the lamp was fixed at ceiling level, horizontal to the beam, shining on to a mirror at 45° to the horizontal. This enabled the source to be as close as possible to the ceiling (Figure 3.18).

3.2.2.6 Thermocouples

The temperatures (Section 3.2.1) have been measured by three sheathed Chromel-Alumel thermocouples, of 0.38 mm in diameter.

3.2.2.7 Data acquisition system

The system is based on a Commodore 4032 computer which is used to control the channel selector (Datron 1220) and digital voltmeter (Datron 1065), a dual drive floppy disc unit (Commodore 4040), a plotter (Hewlett Packard HP 7470A) and a printer (Epson MX80). The interconnection of these units is shown in Figure 3.19. The software was provided by Datron Ltd. It was based on software prepared for the Fire Research Station, and modified to suit the present series of experiments. Two programs were provided, viz. the Scan program which controlled the data logging function, and the Recall program which not only processed the data but also caused the results to be printed and/or plotted.

Table 3.3 gives an example of the printout from the data of one of the experiments. Each set of calculation within the program was checked by manual calculation. Thus the calculation of "total smoke" from the dynamic smoke measurement was checked against a dummy experiment in which a neutral density filter was inserted into the light beam for a known period of time. The agreement was very satisfactory (Figure 3.20).

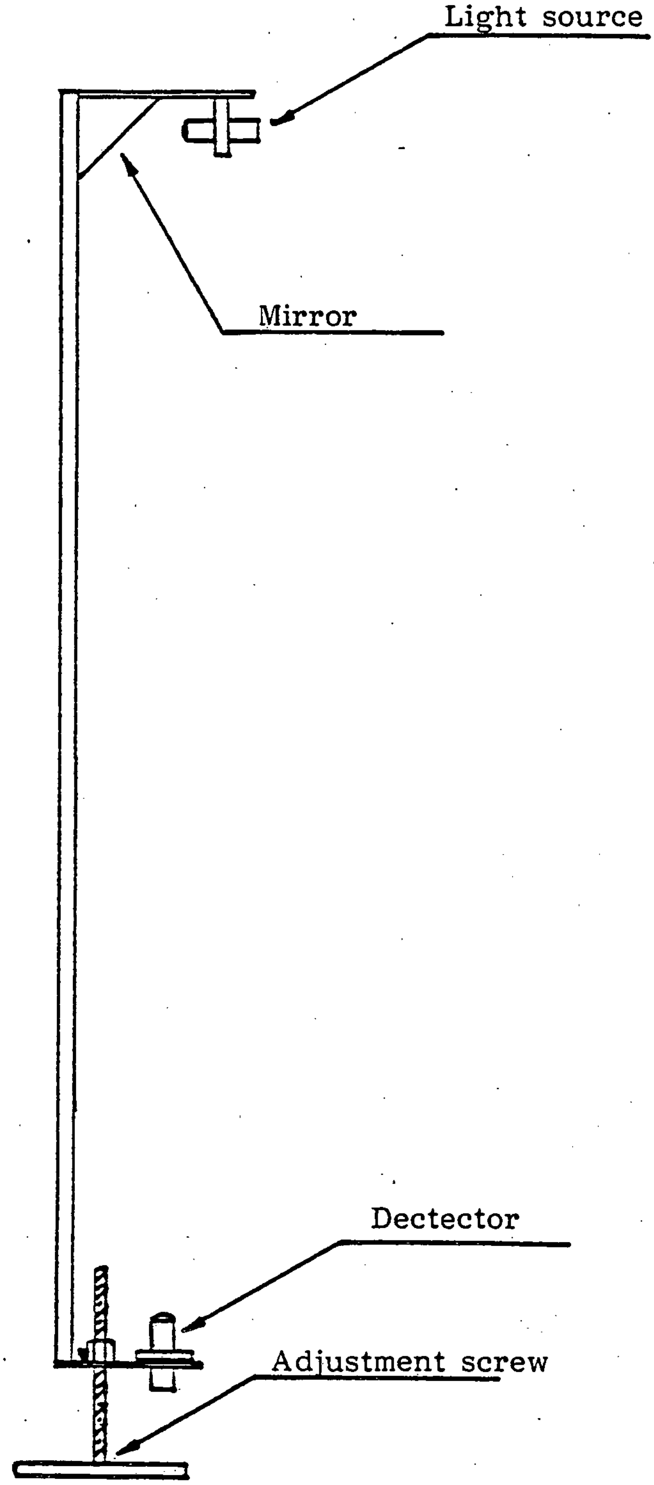


FIGURE 3.18: Light beam.

TABLE 3.3: Sample of printout of the data. (Static measurement only)

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	017	024	019	00.11	0.00	0000	0000	0.09	0.00	00.00	00.000	20.76	0.00	0.00	0.00	000.000	00.000
00.30	017	039	059	00.27	0.00	0000	0000	0.09	0.00	00.00	00.000	20.95	0.00	0.00	0.01	000.000	00.000
01.00	017	054	067	00.33	0.00	0000	0000	0.09	0.00	00.40	00.000	20.43	0.00	0.00	0.01	000.000	00.000
01.30	017	071	100	00.37	0.00	0000	0000	0.09	0.00	00.76	00.097	20.08	0.00	0.00	0.01	000.000	00.000
02.00	017	101	114	00.44	0.00	0000	0000	0.10	0.00	01.27	00.101	19.64	0.00	0.00	0.02	000.000	00.000
02.30	016	157	143	00.51	0.00	0000	0000	0.11	0.00	02.13	00.102	19.01	0.01	0.00	0.02	000.000	00.000
03.00	016	236	187	00.55	0.01	0000	0000	0.13	5.00	03.32	00.111	17.84	0.02	0.00	0.02	000.000	00.000
03.30	017	259	276	00.65	0.03	0000	0000	0.18	0.00	04.67	00.105	16.22	0.04	0.01	0.04	000.000	00.000
04.00	017	300	409	00.68	0.06	0000	0000	0.30	0.00	06.72	00.147	14.76	0.12	0.04	0.12	000.000	00.000
04.30	017	294	462	00.66	0.15	0000	0000	0.67	0.00	08.39	00.340	12.83	0.39	0.11	0.35	000.000	00.000
05.00	017	295	550	00.68	0.46	0000	0000	0.60	0.00	08.47	00.836	11.58	0.27	0.40	0.83	000.000	00.000
05.30	017	299	693	00.66	0.87	0000	0000	0.79	0.00	07.92	00.742	12.17	1.17	0.38	1.40	000.000	00.000
06.00	017	303	567	00.63	1.28	0000	0000	0.77	0.00	07.25	00.320	12.67	1.37	1.17	1.77	000.000	00.000
06.30	017	296	475	00.63	1.59	0000	0000	0.57	0.00	05.19	00.125	14.38	1.30	1.34	1.35	000.000	00.000
07.00	017	268	405	00.60	1.51	0000	0000	0.35	0.00	03.12	00.110	16.77	1.17	1.40	1.30	000.000	00.000
07.30	017	231	344	00.57	1.43	0000	0000	0.29	0.00	02.09	00.137	18.23	1.38	1.62	1.09	000.000	00.000
08.00	017	210	314	00.62	1.51	0000	0000	0.23	0.00	01.59	00.148	18.97	1.15	1.41	1.02	000.000	00.000
08.30	017	196	295	00.59	1.50	0000	0000	0.24	0.00	01.45	00.149	19.23	1.29	1.47	0.99	000.000	00.000
09.00	017	183	276	00.60	1.49	0000	0000	0.22	0.00	01.29	00.155	19.34	1.17	1.53	0.91	000.000	00.000
09.30	017	172	256	00.56	1.37	0000	0000	0.19	0.00	01.09	00.149	19.57	1.22	1.56	1.04	000.000	00.000
10.00	017	166	243	00.36	1.20	0000	0000	0.21	0.00	00.96	00.142	19.67	1.17	1.53	1.06	000.000	00.000
10.30	017	158	233	00.55	1.12	0000	0000	0.17	0.00	00.87	00.143	19.89	1.17	1.52	1.02	000.000	00.000
11.00	017	152	221	00.55	1.10	0000	0000	0.13	0.00	00.80	00.137	19.87	1.07	1.44	1.03	000.000	00.000
11.30	017	146	210	00.52	1.05	0000	0000	0.13	0.00	00.73	00.132	19.93	1.05	1.41	1.03	000.000	00.000
12.00	017	140	202	00.55	1.02	0000	0000	0.16	0.00	00.64	00.125	20.00	1.06	1.41	1.06	000.000	00.000
12.30	017	136	193	00.54	1.00	0000	0000	0.16	0.00	00.63	00.125	20.04	1.05	1.37	1.02	000.000	00.000
13.00	017	132	185	00.53	1.03	0000	0000	0.16	0.00	00.59	00.126	20.09	1.03	1.33	1.03	000.000	00.000
13.30	017	127	179	00.53	1.00	0000	0000	0.15	0.00	00.50	00.118	20.16	1.02	1.28	1.03	000.000	00.000
14.00	017	123	174	00.32	0.99	0000	0000	0.15	0.00	00.45	00.118	20.19	1.06	1.27	1.02	000.000	00.000
14.30	017	120	167	00.52	0.98	0000	0000	0.15	0.00	00.42	00.116	20.26	1.02	1.22	1.03	000.000	00.000
15.00	017	116	162	00.51	0.98	0000	0000	0.16	0.00	00.37	00.113	20.29	1.02	1.18	1.03	000.000	00.000
15.30	017	113	155	00.53	0.97	0000	0000	0.14	0.00	00.35	00.112	20.31	1.01	1.14	1.02	000.000	00.000
16.00	017	110	150	00.50	0.96	0000	0000	0.15	0.00	00.33	00.113	20.35	1.02	1.11	1.01	000.000	00.000
16.30	017	108	143	00.52	0.94	0000	0000	0.13	0.00	00.30	00.111	20.38	1.02	1.08	1.00	000.000	00.000
17.00	017	105	140	00.47	0.94	0000	0000	0.16	0.00	00.27	00.107	20.40	1.02	1.05	0.98	000.000	00.000
17.30	017	103	136	00.42	0.93	0000	0000	0.15	0.00	00.26	00.104	20.43	1.00	1.02	0.99	000.000	00.000
18.00	017	101	134	00.44	0.93	0000	0000	0.15	0.00	00.25	00.107	20.43	1.00	1.02	0.99	000.000	00.000
18.30	017	098	129	00.47	0.92	0000	0000	0.14	0.00	00.19	00.098	20.47	1.00	0.99	0.98	000.000	00.000
19.00	017	095	126	00.45	0.92	0000	0000	0.14	0.00	00.18	00.098	20.50	0.99	0.98	0.98	000.000	00.000
19.30	017	094	122	00.49	0.91	0000	0000	0.13	0.00	00.17	00.096	20.52	0.99	0.97	0.97	000.000	00.000
20.00	017	091	-117	00.49	0.90	0000	0000	0.14	0.00	00.14	00.091	20.54	0.99	0.96	0.97	000.000	00.000

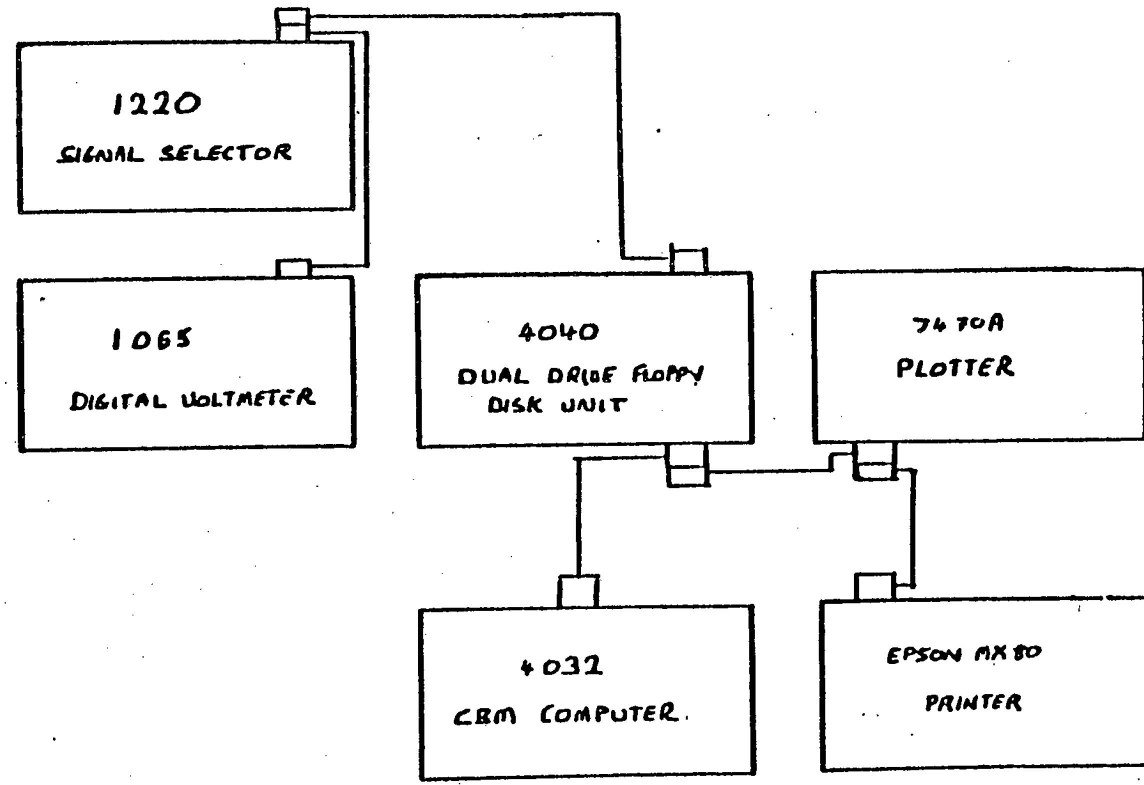


FIGURE 3.19: Data acquisition system (Interconnection).

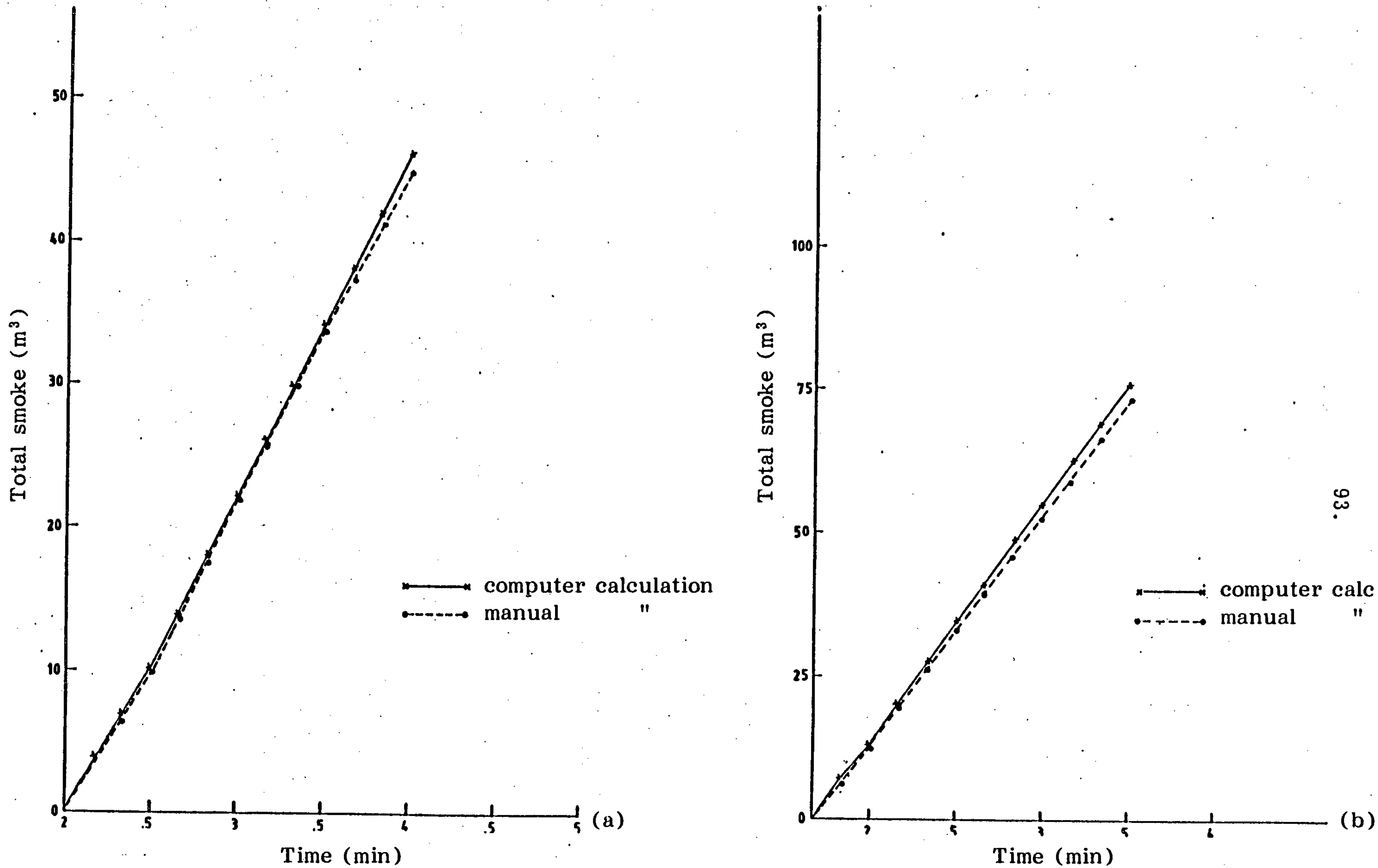


FIGURE 3.20: Dummy test for dynamic measurement.
(a) 50% filter; (b) 32% filter.

3.3 Materials Tested

Fifteen materials were chosen for this project. These are shown in Table 3.4 and fall into three categories: (a) cellulosics, (b) foam plastics and (c) solid plastics. Fifteen materials were tested in EU and Arapahoe tests. Only the first eleven in the table could be tested in the NBS chamber test. For the model compartment tests only three materials were investigated, viz. wood (*Pinus sylvestris*), polymethylmethacrylate (PMMA) and polypropylene (PP).

TABLE 3.4: Materials tested

Category	Material	Thickness (mm)	Density (kg/m^3)
Cellulose	Plywood	12.7	546
	White pinewood	12.7	448
	Fibreboard	12.7	245
	Hardboard	3.0	1037
Foam	Heavy black foam	25.0	175
	Light black foam	18.5	137
	Blue foam	12.7	37
	Yellow foam	12.7	23
	Flexible polyurethane	12.7	22
	Additive foam	12.7	35
Plastic	Polymethylmethacrylate	5.0	1190
	Polypropylene (PP)	3.0	1090
	Polyvinylchloride (PVC)	3.0	1480
	Acrilonitrile-butadiene-styrene (ABS)	3.0	1080
	Polystyrene (PS)	3.0	1040

3.4 Test Procedure

3.4.1 Small scale laboratory test

3.4.1.1 NBS test

The test was carried out according to the procedure described in ASTM-E662.

The sample to be tested measured 76 x 76 mm, with its normal thickness, unless it exceeded 25.4 mm, then was cut to 12.7 mm thick as for yellow, flexible, additive and blue foams. It was weighed and then wrapped in aluminium foil and placed in the sample holder. The aluminium foil was then carefully cut away from the area to be exposed and the sample removed from the holder for weighing. The chamber wall was cleaned as well as the lenses, and all electrical systems switched on to warm up. The sample was then replaced in its holder. For flaming combustion the burner was placed in position and the door and the exhaust duct were closed. After final check and adjustment the sample holder was moved into position in front of the heater by means of a handlebar. The chamber pressure was observed during the test by means of the manometer, the pressure should be ranged 100 ± 50 mm of water. When a negative pressure developed as a result, for example, during intense smoke production, the inlet vent was opened slightly to equalize the pressure. The test was continued until the maximum obscuration was recorded. At this stage the sample was moved away from the front of the heater, the door opened and the sample residue was removed and weighed. The difference between the initial weight of the sample with the aluminium foil and the final residue in the aluminium foil at the end of the test is the weight loss.

3.4.1.2 EU test

The procedure was as follows: with the radiometer directly in front of the heater, the water supply was turned on before switching the electrical supply to the heater. The steady heat output was adjusted by a variable transformer to give the required flux in the plane of the sample surface. The photometric system was left on continuously to avoid warm-up problems, the lenses were cleaned. The sample whose size and method of wrapping were the same as in the NBS test (para 3.4.1.1), was fixed on the holder. For the flaming combustion the burner was lit and the gas flow adjusted. The door of the chamber was closed. After checking the recorder setting, the sample was moved in front of the heater by sliding the plate across, this being the start of the test. The test was continued until the maximum obscuration was reached. The sample was then slid away from the heat source. The smoke was then cleared from the chamber by switching on the extract system. The residue of the sample in the foil was then removed from the apparatus and subsequently weighed.

The effects of varying the test conditions have been investigated. The following variations were examined.

3.4.1.2.1 Position of smoke furnace inside the chamber:

The effect of the position of the smoke furnace inside the chamber was studied. Four different locations were chosen as shown in Figure 3.21, in addition to the normal central position (non-flaming).

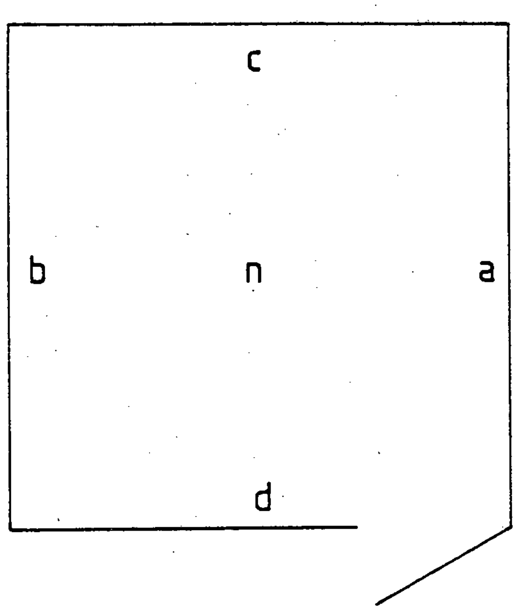


FIGURE 3.21: Smoke furnace positions.

3.4.1.2.2 Effects of stirring the smoke:

The effect of stirring the smoke produced during the tests was studied. To achieve that, a fan was used. Two levels for the fan were selected, at floor level and at a height of 650 mm. Four different positions for the fan were chosen, as shown in Figure 3.22 (non-flaming). (The fan used was a small table fan.)

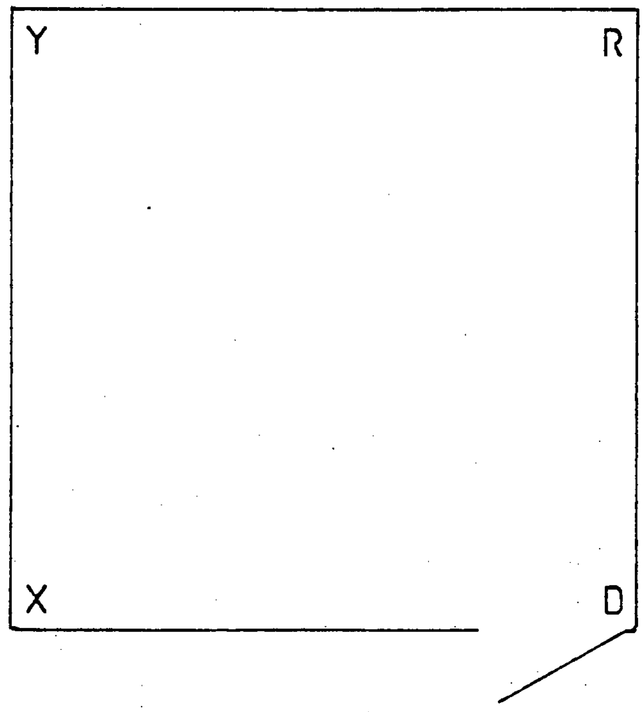


FIGURE 3.22: Fan positions.

3.4.1.2.3 Thickness:

Some of the materials were tested with different thicknesses. For fibreboard pieces, half the normal thickness was cut. Three different thicknesses of PMMA were available for tests. For foam materials, it was cut to the thickness required.

3.4.1.2.4 Thickness by layers:

As some materials may be used in different layers, so the thickness of the sample was varied by using layers of material to make up the desired thickness.

3.4.1.2.5 Combination of two pieces (vertical or horizontal):

The effect of abutting edges was studied by preparing samples from two pieces of material, positioned vertically or horizontally as shown in Figure 3.23.

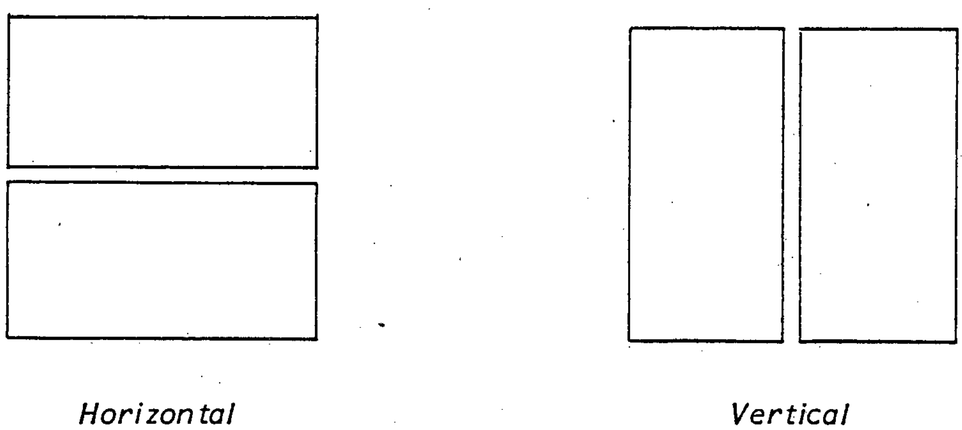


FIGURE 3.23: Abutting edges sample.

3.4.1.2.6 Variation of heat flux:

The heat flux was varied by changing the voltage supply to the surface. The maximum possible flux in these experiments was 3 W/cm^2.

3.4.1.3 Arapahoe test

The size of the sample to be tested was 37.5 x 12.5 x 3.2 mm. The initial weight of the specimen and the filter were determined, the data recorded and the sample placed in the holder with the door left in open position. The filter was installed in the assembly holder as described in Section 3.1.3. The airflow through the apparatus was adjusted to a reading of 120 l/min (4.5 CFM), and the burner ignited with a gas flow of 90 cm^3/min. The door of the combustion chamber was then closed which started the test and simultaneously actuated the clock. After 30 seconds, the burner was turned off: the air flow was allowed to continue for another 30 seconds when it was turned off. The door was opened and the residue of the sample taken from its holder for weighing. The filter was also removed and weighed. For a sample which had charred, the residue was placed in the sandmill which was run for 45 minutes, to remove the char. The final residue was weighed again.

Although the Arapahoe chamber is primarily intended for non-dripping materials which reasonably maintain their shape under flaming conditions, special techniques have been developed to evaluate dripping materials and flexible PVC (Arapahoe test manual, 1982). For flexible PVC, a T-pin was used to support the sample, it is heated and left to cool for 5 seconds and was pressed into the surface of the sample (Figure 3.24a) and then the normal procedure was carried out.

For dripping materials, a standard method has been developed to measure the smoke from polymers. A specimen of the standard size is supported from below by a U-shaped piece of screen (Figure 3.24b), which was positioned on the sample holder and then the test continued as normal procedure. Any material which passed through the screen was collected in a pre-weighed dish beneath the sample, and was treated as unburnt material in the calculation.

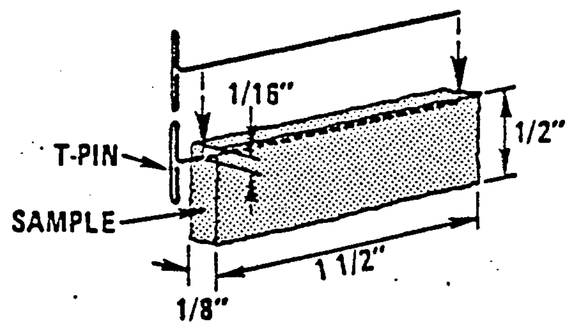


FIGURE 3.24a: Pinning of the sample.

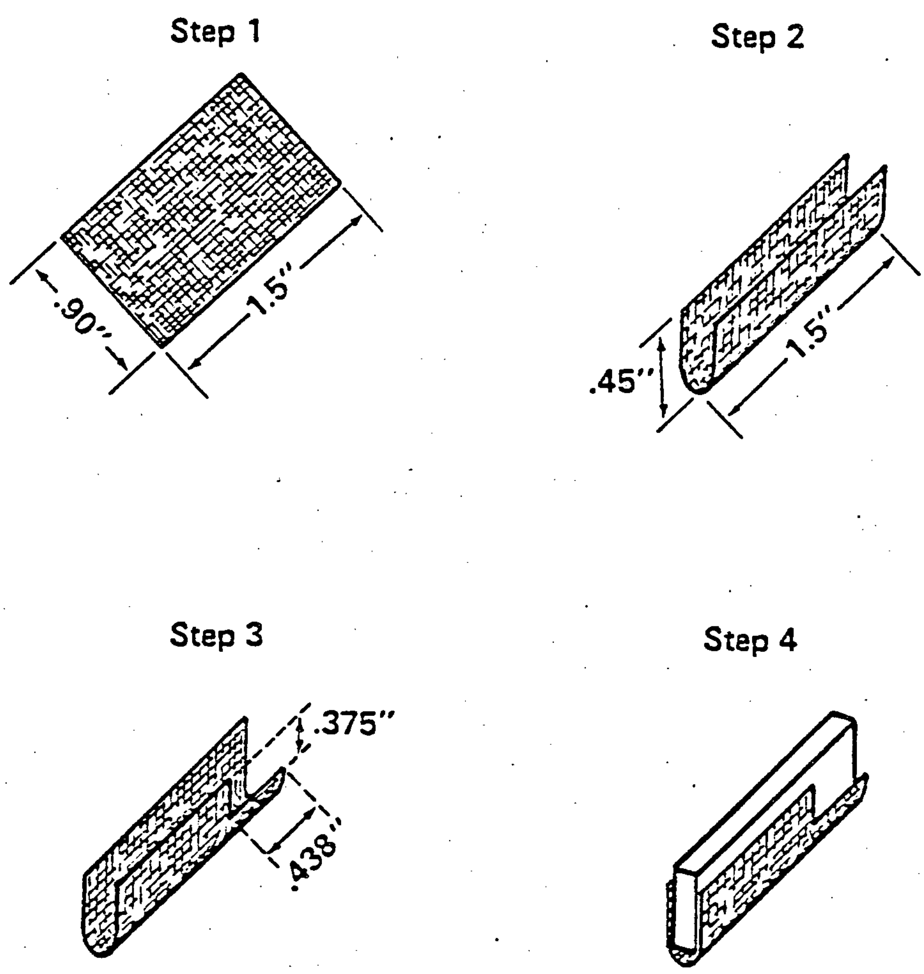


FIGURE 3.24b: Preparation of screen supported sample.

The different parameters were varied to study their effect on the final results.

3.4.1.3.1 Burning time and airflow time (t_b and t_f):

The burning time was varied while keeping the subsequent 30 seconds airflow constant. Two materials were tested (pinewood and PVC) by varying the airflow time while keeping the 30 seconds burning time constant.

3.4.1.3.2 Rate of airflow:

The airflow through the test chamber was also varied, as it was reduced to 50 and 75 per cent of the normal rate.

3.4.1.3.3 Sample position:

The standard distance of 22 mm between the sample and the burner was also varied.

3.4.1.3.4 Thickness of the sample:

Double thickness was tested for two materials, PMMA and pinewood. As the sample holder is constructed for the standard thickness (3.2 mm), so the end of the sample had to be cut accordingly.

3.4.2 <u>*The model compartment series*</u>

The three materials tested were prepared as in Table 3.5 overleaf. Before any experiments were carried out, all equipment was left to warm up. (For the wood cribs, a small piece [~10 gm] was cut out for subsequent determination of moisture content. This involved weighing the sample before and after it had been left in the oven at 100°C for 24 hours. The dry sample was allowed to cool in a dessicator before weighing.) The crib was then placed in the fire box with the required ventilation

TABLE 3.5: Arrangement of materials.

Material	No. of sticks	Length (mm)	Width (mm)	Thickness (mm)	No. of sticks in row	No. of rows	Total area (m^2)	~Weight (gm)
<u>Woodcribs</u>								
a) Large	36	300	22	22	6	6	0.99	2400
b) Medium*	a" 18	300	22	22	3	3	0.50	1200
	b" 18	150	22	22	6	3		
c) Small	49	200	5.5	5.5	7	7	0.22	500
PMMA	15	200	10	3.0	5	3	0.08	240
PP	15	200	10	3.0	5	3	0.08	80

*sticks a and b were laid in alternate layers.

opening. At this stage if the experiment was to be carried out with a corridor, the outer box and the required length of corridor were placed in position. The gas analysis system, the radiometer, the thermocouples and the anemometer were then set up.

The west door to the fire chamber was closed and sealed. The lenses of the photometric system were cleaned. When all was ready, the sample ignited and the scanner was started simultaneously. The person who ignited the sample left the test room quickly, sealing the east door behind him. Different ways of ignition were used depending on the material and presence or absence of the corridor. For woodcribs, two strips of fibreboard, 12.5 x 10 x 80 mm long were used for both large and medium cribs, while for the small two short pieces of the fibreboard strips (40 mm long) were used. Each piece was soaked with methanol, 10 cm^3, for ignition of the large and medium cribs, and 5 cm^3 for the small cribs.

For PMMA and PP ignition, the sample was placed in a tray (220 x 220 mm) with 10 cm^3 of methanol. To ignite the sample (wood, PMMA and PP), manual ignition (by match) was used when possible. However, with a corridor in place, a remote ignition system was used. This involved a small heating coil wound around the heads of few matches and placed close enough to the fuel bed to cause ignition of the methanol when the coil was energised. Each test was continued for twenty minutes, the scanner was stopped and the doors opened to allow the smoke to clear from the chamber. This was the only way of clearing the smoke: under still air conditions, this could take more than an hour.

Introduction

The results obtained by testing the materials are listed in tables in this chapter. They are presented in terms of standard optical density (D_o), as calculated from equation 2.4. The values quoted for D_o refer to the maximum obscuration achieved during the test, in accord with the practice adopted in ASTM 662. As most of the research done elsewhere presented the results in terms of optical density and specific optical density, so in this work, in addition to calculation of D_o, a calculation was made for optical density (D) and specific optical density (D_s), whenever it was possible, and tabulated.

Each experiment was repeated at least three times for NBS and EU tests, six times for Arapahoe test and twice for the compartment test. The average and the standard deviations have been calculated. For each compartment fire, all the measurements are included in single tables. The individual tables for all the experiments are in Appendix II.

4.1 Results For Small Laboratory Tests

4.1.1 The NBS Chamber

Eleven materials were tested with each repeated three times for flaming and non-flaming combustion. The tests were carried out at the Yarsley Technical Centre, Redhill, Surrey. The procedure was demonstrated by the technician responsible for the equipment which was then operated under his supervision. The method was straightforward but it was time-consuming to arrange everything and to wait for the wall temperature (35 ± 2°C) to stabilize. The equipment could be operated by one person.

The percentage light transmission and time were recorded continuously from the beginning until maximum obscuration was achieved. The mass loss was calculated by weighing the sample before and after the test. The results for both flaming and non-flaming of the eleven materials are shown in Table 4.1. Generally, D_o was less for flaming than for non-flaming combustion, although the reverse was true for the heavy and light black foam. The weight losses were higher with flaming than non-flaming combustion for eight of the eleven materials. The time taken to reach the maximum obscuration (t_m) was much longer for the non-flaming combustion. The results for flaming combustion show a much higher standard deviation than those under non-flaming conditions. The best repeatability is observed with cellulosic materials.

4.1.2 *Edinburgh test (EU test)*

Fifteen materials were tested with EU chamber. The weight loss was measured, the percentage light transmission was recorded, and then the D_o was calculated.

The results are presented in Table 4.2. Higher D_o was recorded under non-flaming than flaming combustion except for PMMA. For cellulosic and foam materials, the weight loss was higher for non-flaming than flaming combustions. The time to maximum obscuration was greater also for non-flaming, with ten materials exceeding the twenty minutes period specified in the NBS test. The results for non-flaming combustion showed better repeatability.

Different variations in the conditions of EU chamber test have been tested, as follows.

TABLE 4.1: NBS chamber results.

Material	D (ob)	Weight loss (gm)	D_0 (obm³/gm)	Standard deviation ±	D_s	t_m (min)	% Weight loss
Plywood	7.1	24.14	0.15	0.01	86	15.2	64
White pine wood	17.1	21.80	0.4	0.01	206	16.6	69
Fibreboard	0.46	7.82	0.03	0.001	5.5	3.8	41
Hardboard	4.0	13.60	0.15	0.006	49	4.8	75
Heavy black foam	9.2	3.91	1.2	0.08	110	7.2	16
Light black foam	7.0	3.25	1.1	0.12	84	8.0	22
Blue foam (DR 265)	12.5	2.19	2.9	0.24	150	8.8	84
Yellow foam (D.7)	10.6	1.46	3.7	0.48	128	8.0	89
Flexible polyurethane	10.6	1.29	4.2	0.18	127	8.7	83
Additive foam	14.8	2.36	3.2	0.41	179	7.7	86
PMMA	4.2	21.42	0.1	0.002	51	6.2	71

(a) Flaming

Plywood	40.1	18.59	1.1	0.10	483	17.2	46
White pine wood	58.6	17.58	1.7	0.08	706	19.5	57
Fibreboard	42.3	11.15	1.9	0.07	510	10.2	60
Hardboard	53.2	11.80	2.3	0.13	640	12.2	65
Heavy black foam	8.1	5.90	0.7	0.03	97	13.5	25
Light black foam	6.1	3.11	1.0	0.03	73	9.4	21
Blue foam	11.1	1.26	4.5	0.21	133	19.3	49
Yellow foam	16.2	1.20	6.9	0.19	195	12.2	73
Flexible polyurethane	10.4	0.7 ~~3.09~~	6.6	0.91	125	17.0	52
Additive foam	15.9	1.39	5.8	0.81	192	10.0	52
PMMA	7.5	23.91	0.16	0.01	90	25.0	66

(b) Non-flaming

TABLE 4.2: EU test results.

Material	D (ob)	Weight loss (gm)	D_0 (obm³/gm)	Standard deviation ±	D_s	t_m (min)	% Weight loss
Plywood	0.17	23.38	0.1	0.01	55	19.1	66
White pine wood	0.32	22.11	0.20	0.012	104	12.5	72
Fibreboard	0.10	14.51	0.09	0.001	31	7.0	85
Hardboard	0.2	13.75	0.2	0.01	68	6.0	78
Heavy black foam	0.06	4.13	0.2	0.01	20	6.7	16
Light black foam	0.03	2.06	0.2	0.02	9	3.0	13
Blue foam	0.03	0.83	0.5	0.05	11	1.0	33
Yellow foam	0.035	1.12	0.43	0.04	11	1.0	69
Flexible foam	0.05	1.20	0.54	0.02	15	3.0	72
Additive foam	0.091	0.92	1.37	0.05	30	2.0	38
PMMA	0.52	32.55	0.22	0.008	168	13.0	96
Polystyrene	1.53	9.10	2.31	0.17	498	6.6	50
Polypropylene	0.10	4.25	0.33	0.03	34	4.9	27
PVC	3.01	17.59	2.35	0.19	980	11.7	71
ABS	4.41	16.09	3.77	0.14	1436	7.3	86

(a) Flaming

Plywood	2.7	28.56	1.3	0.1	879	23.1	78
White pine wood	4.62	26.33	2.41	0.09	1491	24.8	79
Fibreboard	1.67	12.55	1.83	0.08	543	12.0	73
Hardboard	3.10	15.22	2.8	0.12	1009	15.8	88
Heavy black foam	0.32	11.01	0.4	0.01	104	32.7	44
Light black foam	0.20	4.58	0.6	0.06	70	19.9	32
Blue foam	0.62	1.58	5.4	0.31	201	37.9	61
Yellow foam	0.62	1.40	6.1	0.76	201	15.4	85
Flexible foam	0.54	1.13	6.55	0.2	175	21.0	65
Additive foam	0.60	1.48	5.44	0.18	190	12.5	61
PMMA	0.12	26.58	0.06	0.003	39	20.0	78
Polystyrene	2.49	7.53	4.56	0.33	809	50.2	41
Polypropylene	3.15	7.76	5.58	0.12	1024	42.5	50
PVC	2.77	17.75	2.15	0.09	903	33.5	71
ABS	4.25	9.16	6.39	0.17	1384	30.9	49

(b) Non-flaming

4.1.2.1 Position of smoke furnace inside the chamber

Although there were small variations in D_o and D_s, these were not significant (Table 4.3: fibreboard, non-flaming).

TABLE 4.3: Variation of measured smoke density with furnace position.

Position (Fig. 3.21)	No. of test	D (Ob)	D_o ($Ob.m^3/gm$)	Standard deviation	D_s	% Weight loss	t_m (min)
a	3	1.70	1.93	±0.12	550	76	12
b	5	1.64	1.91	±0.10	531	74	13
c	4	1.75	1.86	±0.14	570	77	14
d	3	1.69	1.91	±0.07	547	74	12
n	7	1.67	1.83	±0.08	544	73	12

4.1.2.2 Effects of stirring the smoke

Fibreboard was tested under non-flaming combustion. The results are presented in Table 4.4.

TABLE 4.4: Variation of smoke density with stirring.

Position of the fan (Fig. 3.22)	Level of fan	D (Ob)	D_o ($Ob.m^3/gm$)	Standard deviation	D_s	% Weight loss	t_m (min)
X	Floor	1.73	1.85	±0.13	563	76	14
R	Floor	1.69	1.88	±0.11	547	73	13
Y	Floor	1.73	1.89	±0.09	563	75	14
D	Floor	1.67	1.79	±0.09	544	75	12
X	65 cm above floor	1.65	1.73	±0.16	534	75	14
R	65 cm above floor	1.78	1.88	±0.12	576	77	13
Y	65 cm above floor	1.70	1.81	±0.10	553	75	13
D	65 cm above floor	1.62	1.84	±0.06	527	74	12
without fan		1.67	1.83	±0.08	544	73	12

There was no significant change in D_o or D_s, with the fan in different locations, although some differences were found in the early stages of smoke production (see Section 5.1.2.2).

4.1.2.3 Thickness of the sample

Four materials were tested here under flaming and non-flaming conditions:

4.1.2.3.1 Fibreboard (Table 4.5):

(a) Flaming combustion. D_o for the thinner was about 30% more than that of the thicker sample, D_s was about twice for the thicker. The percentage weight loss was about the same. The thicker reached the maximum obscuration in a time twice that for the thinner sample.

(b) Non-flaming combustion. With increasing thickness, D_o, t_m and per cent weight loss were decreased, while D_s was increased.

4.1.2.3.2 PMMA (Table 4.6):

(a) Flaming combustion. Three thicknesses of this particular grade of PMMA were available, viz. 3, 5 and 6 mm. A 10 mm thick sample was prepared by combining two samples of 5 mm thickness by sticking them together using perspex cement. D_s increased in proportion to the thickness. The thinnest sample gave the highest value of D_o. The per cent weight loss was almost the same. With increasing the thickness, t_m was increased.

(b) Non-flaming combustion. D_s increased roughly in proportion to the sample thickness. However, D_o was significantly higher for the 3 mm sheet than for the thicker three (5, 6 and 10 mm). The per cent weight losses were the same.

TABLE 4.5: Smoke yield from different thickness of PMMA

Combustion	Thickness (mm)	D (ob)	Weight loss (gm)	D_o (obm^3/gm)	St. dev. ±	D_s	St. dev. ±	t_m (min)	% Weight loss
Flaming	3	0.38	19.94	0.26	0.006	123	6.1	6.5	94
	5	0.52	32.55	0.22	0.008	168	4.8	13.0	96
	6	0.70	39.29	0.25	0.006	228	10.3	16.0	96
	10	1.06	69.92	0.21	0.011	345	20.5	17.0	98
Non-flaming	3	0.08	15.88	0.07	0.003	27	1.0	14.0	76
	5	0.12	26.58	0.06	0.004	39	2.5	20.0	78
	6	0.14	31.84	0.06	0.003	44	1.4	22.5	79
	10	0.25	58.40	0.06	0.005	81	5.2	41.0	82

TABLE 4.6: Smoke yield from different thickness of Fibreboard

Combustion	Thickness (mm)	D (ob)	Weight loss (gm)	D_o ($ob.m^3/gm$)	St. dev. ±	D_s	St. dev. ±	t_m (min)	% Weight loss
Flaming	6.4	0.06	7.10	0.12	0.002	17	0.9	4.0	89
	12.7	0.10	14.51	0.09	0.001	31	2.5	7.0	85
Non-flaming	6.4	1.21	7.11	2.34	0.07	394	21.0	8.0	89
	12.7	1.67	12.55	1.83	0.08	543	29.0	12.0	73

4.1.2.3.3 Additive foam (Table 4.7):

(a) Flaming combustion. As the thickness is increased, the specific optical density was found to increase in proportion, while, within the scatter of the data, D_o remained approximately constant. The per cent weight loss was independent of thickness.

(b) Non-flaming combustion. The observation was similar to flaming combustion although the yield of smoke was greater. The time to maximum obscuration (t_m) was increased with increasing thickness.

4.1.2.3.4 Flexible polyurethene foam (Table 4.8):

(a) Flaming combustion. The results were similar to those for additive foam, with less scatter in data.

(b) Non-flaming combustion. An increase in the thickness gave increased D_s, but no significant change in D_o. There was also some decrease of the per cent weight loss with the increase of the thickness.

4.1.2.4 Effects of layers

The thickness of the sample was varied by using layers of material to make up the desired thickness.

4.1.2.4.1 Fibreboard (Table 4.9):

Non-flaming only, D_s varied with the arrangmeent of the layers as a result of differences in the per cent weight loss. The variation of D_o was not significant.

4.1.2.4.2 PMMA (Table 4.10):

There was no significant change for D_o when comparing the two layers of 5 mm each with one single piece of 5 mm thickness. The D_s

TABLE 4.7: Smoke yield from different thicknesses of additive foam.

Combustion	Thickness (mm)	D (ob)	Weight loss (gm)	D_o obm³/gm	St. dev. ±	D_s	St. dev. ±	t_m (min)	% Weight loss
flaming	6.4	0.05	0.42	1.54	0.07	15	1.0	1.0	37
	12.7	0.09	0.92	1.37	0.05	30	2.1	2.0	38
	19.0	0.15	1.43	1.45	0.05	49	1.4	2.0	39
	25.4	0.20	1.93	1.43	0.02	65	0.7	2.0	40
non-flaming	6.4	0.27	0.70	5.32	0.35	88	5.2	11.0	60
	12.7	0.59	1.48	5.44	0.18	190	3.9	12.5	61
	19.0	1.01	2.16	6.43	0.4	329	5.8	15.0	60
	25.4	1.37	3.08	6.12	0.22	446	5.1	19.0	61

TABLE 4.8: Smoke yield from different thicknesses of flexible polyurethane foam.

Combustion	Thickness (mm)	D (ob)	Weight loss (gm)	D_o obm³/gm	St. dev. ±	D_s	St. dev. ±	t_m (min)	% Weight loss
flaming	6.4	0.03	0.65	0.57	0.03	9	0.6	2.0	75
	12.7	0.05	1.20	0.54	0.02	15	0.7	3.0	72
	19.0	0.07	1.75	0.53	0.01	22	0.5	5.0	70
	25.4	0.10	2.62	0.50	0.04	31	1.1	4.0	77
non-flaming	6.4	0.31	0.67	6.26	0.14	99	8.1	21.0	77
	12.7	0.54	1.13	6.55	0.20	175	5.6	21.0	65
	19.0	0.77	1.52	6.97	0.30	252	15.0	22.0	57
	25.4	0.97	1.88	7.15	0.43	317	12.5	22.0	55

TABLE 4.9: Effect of layers on smoke yield for fibreboard.

Layers	D (ob)	Weight loss (gm)	D_o (ob.m³/gm)	St. dev. ±	D_s	t_m (min)	% Weight loss	Total thickness (mm)
Two layers 2 x 12.7	3.95	28.10	1.93	∓0.1	1286	26	83.7	25.4
Three layers 1 complete + 2 halves	3.81	26.95	1.94	∓0.06	1240	26	81.0	
Three layers 2 halves(F) + 1 complete (B)*	2.99	21.82	1.88	∓0.08	973	20	65.8	
Four halves 4 x 6.4	2.86	21.31	1.96	∓0.1	931	20	68.7	
Two layers 1 complete + 1 half	2.63	18.90	1.91	∓0.08	851	18	75.6	19.0
Three layers 3 x 6.4	2.31	16.22	1.95	∓0.06	752	16	72.2	
Two layers 2 x 6.4	1.95	12.95	2.07	∓0.05	635	14	80.2	12.7

*F = front; B = back

TABLE 4.10: Effect of layers on smoke yield of PMMA.

No. of layers	D (ob)	Weight loss (gm)	D_o (ob.m^3/gm)	St. dev. ±	D_s	t_m (min)	% Weight loss	Thickness (mm)
1	0.516	32.55	0.22	$\mp$0.008	168	13	95.7	5
2*	0.94	63.20	0.205	$\mp$0.01	306	19	95.0	10

*not glued together.

was double. A slight increase of the t_m was noticed, the test done under flaming conditions.

4.1.2.4.3 Additive foam (Table 4.11):

Different combinations of different numbers of layers have been tested here, which gave total thickness of 25.4, 19.0, 12.7 and 6.4 mm. There was no significant change for D_s, D_o or the per cent weight loss within each thickness (flaming or non-flaming). There was no significant change for a constant thickness as a single layer on multiple layers.

4.1.2.4.3 Flexible polyurethane foam (Table 4.12):

There was no significant change in D_s and D_o for the same thickness with different combinations of layers, either for flaming or non-flaming combustions. D_o is greater for the multiple layers than for a single layer of the same thickness.

4.1.2.5 Combination of two pieces

4.1.2.5.1 To test the effect of joints, samples were made from two pieces of material, 76 mm x 38 mm (Figure 3.23). At first for the same material (fibreboard and PMMA), and after, a combination of fibreboard and PMMA (76 x 38 mm each) were tested.

(a) Fibreboard (Table 4.13a). For flaming, there was no significant change for smoke potential. Under non-flaming conditions, both D_s and D_o were higher than that of a complete piece sample. Under flaming and non-flaming conditions, there was no change for t_m.

(b) PMMA (Table 4.13b). There was no significant change for D_s, D_o and the t_m for flaming and non-flaming combustions.

TABLE 4.11: Effect of layers on smoke yield for additive foam.

Type of combustion	Layers	D (ob)	Weight loss (gm)	D_o (ob.m³/gm)	St. dev.	D_s	T_m (min)	% Weight loss
Flaming	2 layers 6.4(F) + 19.0(B)*	0.21	1.86	1.53	∓0.02	67.4	1.1	39.1
	2 layers 19.0(F) + 6.4(B)	0.23	2.00	1.58	0.07	74.9	1.2	41.4
	2 layers 2 x 12.7	0.23	2.07	1.53	∓0.02	74.9	1.2	41.0
	4 layers 4 x 6.4	0.21	1.94	1.49	∓0.04	68.3	2.0	38.7
	2 layers 6.4(F) + 12.7(B)	0.15	1.39	1.49	∓0.03	49.1	1.5	38.5
	3 layers 3 x 6.4	0.15	1.45	1.40	0.04	48.2	2.5	39.6
	2 layers 2 x 6.4	0.09	0.85	1.42	∓0.02	28.8	1.5	34.7
Non-flaming	2 layers 6.4(F) + 19.0(B)	1.46	3.08	6.51	∓0.1	475.2	14.0	59.2
	2 layers 19.0(F) + 6.4(B)	1.48	2.99	6.80	∓0.2	481.7	12.0	57.3
	2 layers 2 x 12.7	1.46	3.00	6.70	∓0.1	475.2	13.0	55.8
	4 layers 4 x 6.4	1.47	2.90	6.97	∓0.05	478.4	13.0	59.2
	2 layers 6.4(F) + 12.7(B)	0.98	2.04	6.60	∓0.08	318.9	12.5	59.1
	3 layers 3 x 6.4	1.0	2.10	6.54	∓0.06	325.4	14.0	62.3
	2 layers 2 x 6.4	0.61	1.41	5.95	0.05	198.5	11.5	58.2

*F = front; B = back

TABLE 4.12: Effects of layers on smoke yield for flexible polyurethane foam.

Type of combustion	Layers	D (ob)	Weight loss (gm)	D_o (ob.m³/gm)	St. dev.	D_s	T_m (min)	% Weight loss
Flaming	2 layers 6.4(F) + 19.0(B)*	0.093	2.51	0.51	$\mp$0.01	23.8	6.5	76.8
Flaming	2 layers 19.0(F) + 6.4(B)	0.092	2.41	0.53	$\mp$0.01	30.0	6.0	72.0
Flaming	2 layers 2 x 12.7	0.102	2.61	0.54	$\mp$0.02	35.8	6.5	78.9
Flaming	4 layers 4 x 6.4	0.100	2.55	0.54	0.03	32.5	6.5	77.2
Flaming	2 layers 6.4(F) + 12.7(B)	0.068	1.63	0.58	0.01	22.1	6.0	68.3
Flaming	3 layers 3 x 6.4	0.073	1.86	0.54	0.02	23.8	6.5	71.6
Flaming	2 layers 2 x 6.4	0.049	1.14	0.59	0.01	15.9	5.0	72.0
Non-flaming	2 layers 6.4(F) + 19.0(B)	1.02	1.89	7.42	$\mp$0.1	332.0	35.0	52.4
Non-flaming	2 layers 19.0(F) + 6.4(B)	0.96	1.80	7.33	$\mp$0.2	312.0	35.0	50.8
Non-flaming	2 layers 2 x 12.7	0.95	1.81	7.21	$\mp$0.1	308.0	36.0	51.9
Non-flaming	4 layers 4 x 6.4	0.91	1.73	7.23	$\mp$0.1	296.0	37.0	50.0
Non-flaming	2 layers 6.4(F) + 12.7(B)	0.70	1.36	7.08	$\mp$0.2	228.0	35.0	52.1
Non-flaming	3 layers 3 x 6.4	0.74	1.43	7.12	$\mp$0.1	241.0	34.0	54.7
Non-flaming	2 layers 2 x 6.4	0.50	1.00	6.87	$\mp$0.1	162.0	34.0	57.7

*F = front; B = back.

TABLE 4.13a: Smoke yield from two pieces of fibreboard.

Mode of combustion	Arrangement	D (ob)	Weight loss (gm)	D_o (ob.m^3/gm)	St. dev. ±	D_s	t_m (min)	% Weight loss
Flaming	Vertical	0.03	4.59	0.09	0.01	10	7	27
	Horizontal	0.03	5.16	0.08	0.01	10	7	30
	One complete piece	0.10	14.51	0.09	0.01	31	7	85
Non-flaming	Vertical	2.99	13.58	3.04	0.10	976	12	80
	Horizontal	2.71	13.09	2.84	0.15	879	12	76
	One complete piece	1.67	12.55	1.83	0.08	543	12	73

TABLE 4.13b: Smoke yield from two pieces of PMMA.

Mode of combustion	Arrangement	D (ob)	Weight loss (gm)	D_o (ob.m^3/gm)	St. dev. ±	D_s	t_m (min)	% Weight loss
Flaming	Vertical	0.50	32.81	0.21	0.01	163	12	97
	Horizontal	0.53	32.58	0.22	0.011	172	13	96
	One complete piece	0.52	32.55	0.22	0.008	168	13	96
Non-flaming	Vertical	0.12	27.03	0.06	0.004	39	21	80
	Horizontal	0.13	27.71	0.06	0.005	42	19	81
	One complete piece	0.12	26.58	0.06	0.003	39	20	78

TABLE 4.13c: Smoke yield from a combination of fibreboard and PMMA.

	Arrangement	D (ob)	Total weight loss (gm)	D_o (ob.m^3/gm)	SD	D_s	Fibreboard weight (gm)	Fibreboard loss (%)	PMMA weight (gm)	PMMA loss (%)	t_m (min)	% Weight loss (total)
Flaming	½ Fibreboard + ½ PMMA Vertical	0.281	22.80	0.169	∓0.001	91.4	6.78	80.4	16.02	95.0	11.0	90.2
Flaming	½ Fibreboard (top) + ½ PMMA (lower) Horizontal	0.310	21.99	0.194	∓0.007	100.9	6.46	77.0	15.53	90.0	9.0	85.8
Flaming	½ fibreboard (lower) + ½ PMMA (top) Horizontal	0.201	21.51	0.128	∓0.001	65.4	6.08	74.1	15.43	91.8	9.0	85.2
Non-flaming	½ Fibreboard + ½ PMMA Vertical	1.04	20.04	0.71	0.01	337.0	7.04	84.4	13.0	76.0	16.0	78.8
Non-flaming	½ Fibreboard (top) + ½ PMMA (lower) Horizontal	0.912	20.17	0.62	0.02	297.0	6.77	81.4	13.4	79.6	18.0	80.2
Non-flaming	½ Fibreboard (lower) + ½ PMMA (top) Horizontal	0.944	20.93	0.62	0.01	307.0	6.86	85.3	14.1	83.3	16.7	84.8

(c) Combination of fibreboard and PMMA (Table 4.13c). For flaming combustion, when the pieces had their long axes horizontal, there was a change in both D_S and D_o as a result of changing the relative position of fibreboard and PMMA. The weight losses and t_m did not vary significantly. In the vertical position, both D_S and D_o lay in between the results obtained for the two horizontal configurations. There was no significant difference in the results for the three configurations under non-flaming combustion.

4.1.2.5.2 Separate layers of different materials:

Fibreboard and PMMA have been tested, either the PMMA in front and fibreboard in the rear, or vice versa. The results are presented in Table 4.14, which show that there was a change in D_o and D_S for the different arrangement of the composite. Comparing D_o measured with the predicted D_o, there was no significant difference except when the PMMA was in front under non-flaming combustion. The rate of smoke production when the fibreboard was in front, was quicker than when the PMMA was in front.

4.1.2.6 Heat flux variation

(a) Fibreboard (Table 4.15). There was an increase in both D_o and D_S when the energy level increased under non-flaming combustion.

(b) Whitepine (Table 4.16). Under flaming conditions, there was a significant increase of both D_S and D_o with the increase of the heat flux. The weight loss and t_m increased with the increase of the heat flux as well. Under non-flaming, D_S, D_o and the weight loss increased when the heat flux was increased, while the t_m decreased.

TABLE 4.14: Smoke yield from layers of fibreboard and PMMA.

Type of combustion	Composite	D	Weight loss (total)	D_o measured	St. dev. ±	D_o predicted	D_s	Weight loss fibre board	Weight loss PMMA	% Weight loss	t_m
Flaming	Fibreboard (F)* + PMMA (B)	0.503	33.48	0.207	0.03	0.167	164	13.47	20.01	66.2	21.0
	PMMA (F) + fibreboard (B)	0.643	34.38	0.174	0.01	0.177	209	16.13	34.38	97.3	16.0
	½ Fibreboard (F) + PMMA (B)	0.574	30.57	0.213	0.02	0.196	187	6.41	30.57	89.7	20.0
Non-flaming	Fibreboard (F) + PMMA (B)	1.98	14.22	1.91	0.01	1.69	644	13.07	1.15	28.2	15.5
	PMMA (F) + fibreboard (B)	3.97	49.12	1.11	0.005	0.66	1291	16.50	32.62	95.3	26.0
	½ Fibreboard (F) + PMMA (B)	1.16	29.72	0.54	0.006	0.46	378	6.86	22.86	69.5	6.0

*F = front; B = back.

TABLE 4.15: Effect of heat flux on smoke yield for fibreboard (non-flaming).

H.F W/m^2	D (ob)	Weight loss (gm)	D_o obm³/gm	St. devia. ±	D_s	St. devia. ±	t_s (min)	t_m (min)	% Weight loss
1.00	0.95	8.22	1.59	0.03	309	19	3.5	14.0	49
1.50	1.18	9.49	1.71	0.03	384	20	2.5	12.5	55
2.00	1.48	11.43	1.78	0.05	482	26	1.0	12.5	68
2.25	1.58	12.21	1.84	0.02	514	26	0.8	12.0	71
2.50	1.67	12.55	1.83	0.08	543	29	0.6	12.0	73
2.90	1.96	13.08	2.06	0.10	670	46	0.4	11.0	77

TABLE 4.16: Effect of heat flux on smoke yield from white pine.

HF w/cm²	D (ob)	Weight loss	D_o ob.m³/gm	Standard deviation ±	D_s	Standard deviation ±	t_s	t_m	% Weight loss
1.00	0.02	6.01	0.05	0.004	7	0.05	1.0	1.2	18
1.50	0.03	7.17	0.06	0.002	10	0.02	1.0	4.5	21
1.75	0.05	9.81	0.07	0.004	16	0.8	0.8	5.8	30
2.00	0.11	14.33	0.11	0.006	36	1.0	0.7	9.0	43
2.25	0.22	18.88	0.16	0.005	71	1.2	0.6	11.8	55
2.50	0.32	22.11	0.20	0.012	104	4.2	0.6	12.5	72
3.0	0.38	25.04	0.21	0.01	124	5.1	0.4	14.5	75

Flaming

1.00	0.06	4.73	0.17	0.005	20	1.5	3.0	54	14
1.50	1.58	20.55	1.05	0.03	513	30	2.0	46	61
2.00	3.18	23.87	1.83	0.05	1034	24	1.0	30	68
2.50	4.62	26.33	2.41	0.09	1491	40	0.5	25	79
3.00	5.55	28.09	2.72	0.03	1808	42	0.3	20	82

Non-flaming

(c) Heavy black foam (Table 4.17). Under flaming and non-flaming conditions, D_S, D_o and weight loss increased when the heat flux was increased. t_m was increased under flaming, while under non-flaming conditions there was no significant change.

(d) PMMA (Table 4.18). D_S and D_o increased with the increase of heat flux under flaming conditions. Although the increase was less marked above 2 w/cm^2, t_m was shorter for the higher fluxes. Under non-flaming conditions, as the heat flux was increased, D_S, D_o and the weight loss were increased. There was no significant change in t_m.

4.1.3 *Arapahoe chamber test*

The results of fifteen materials are shown in Table 4.19, the individual results are presented in Table 4.20 a to o.

Smoke has been calculated based on weight loss and on initial weight. The amount of char produced was determined also for the cellulosic materials. The standard deviation of the mean value did not exceed 20% for all materials tested. The solid plastics with the exception of PMMA were found to produce higher percentage of smoke compared with the cellulosic materials.

The different parameters were varied to study their effect and importance in determining the final results, as follows.

4.1.3.1 *The burning time*

The burning time was varied while keeping the subsequent 30 seconds airflow constant. Two materials were tested and the results are presented in Table 4.21.

TABLE 4.17: Effect of heat flux on smoke yield from heavy black foam.

H.F W/cm²	D (ob)	Weight loss (gm)	D_o obm³/gm	St. dev. ±	D_s	St. dev. ±	t_m (min)	% Weight loss	D_o C of V
1.00	0.02	2.01	0.137	0.003	6.50	0.3	1.0	7.0	2.2
1.50	0.03	2.49	0.166	0.006	9.80	0.3	2.1	10.0	3.6
2.00	0.05	3.81	0.180	0.006	16.3	1.0	2.7	15.0	3.3
2.50	0.06	4.12	0.200	0.01	19.5	1.2	6.7	16.0	5.0
3.00	0.08	5.01	0.222	0.009	26.4	1.0	9.0	20.0	4.1

Flaming

1.00	0.143	6.79	0.29	0.03	47	1.5	30.0	28	10.3
1.50	0.186	8.02	0.32	0.01	61	2.4	30.0	32	3.1
2.00	0.230	9.45	0.34	0.02	75	1.9	32.5	38	5.9
2.50	0.320	11.01	0.40	0.01	104	6.1	32.7	44	2.5
3.00	0.364	11.50	0.44	0.01	119	1.5	32.0	45	2.3

Non-flaming

TABLE 4.18: Effect of heat flux on smoke yield from PMMA.

H.F W/cm²	D (ob)	Weight loss (gm)	D_o obm³/gm	St. dev. ±	D_s	St. dev. ±	t_s (min)	t_m (min)	% Weight loss
1.00	0.19	26.13	0.100	0.004	62	1.6	10.0	21.0	78
1.25	0.23	27.38	0.116	0.005	75	3.3	7.5	19.0	81
1.50	0.28	30.21	0.127	0.003	91	1.6	6.0	18.0	89
1.75	0.39	31.02	0.172	0.008	126	6.5	4.5	16.0	93
2.00	0.48	31.56	0.210	0.006	157	6.4	4.5	15.0	93
2.25	0.49	31.43	0.213	0.005	159	3.2	3.5	14.0	92
2.50	0.52	32.55	0.218	0.008	168	3.1	3.0	13.0	96
2.75	0.55	32.28	0.233	0.010	178	15.0	2.5	13.0	95
3.00	0.59	32.94	0.245	0.007	191	13.1	2.0	12.0	95

Flaming

1.25	0.02	8.53	0.029	0.002	6	0.3	17.0	21.0	25
1.50	0.04	14.49	0.037	0.002	13	0.9	13.0	21.0	43
1.75	0.06	18.23	0.046	0.001	20	0.04	11.0	20.0	54
2.00	0.08	21.53	0.053	0.003	27	1.0	9.0	20.0	63
2.25	0.10	24.36	0.057	0.001	33	0.02	8.0	20.0	72
2.50	0.12	26.58	0.060	0.003	39	0.9	7.5	20.0	78
2.75	0.13	28.37	0.063	0.003	42	1.1	7.0	20.0	83
3.00	0.16	29.36	0.074	0.005	52	0.8	6.0	20.0	86

Non-flaming

TABLE 4.19: Arapahoe results (average).

Material	Weight (gm)	Weight loss (gm)	% Smoke based on wt. loss	St. dev. ±	% Smoke based on In. weight	St. dev. ±
Plywood	0.840	0.439	0.51	0.06	0.27	0.04
Pinewood	0.671	0.424	1.05	0.05	0.67	0.06
Fibreboard	0.370	0.287	0.71	0.09	0.55	0.10
Hardboard	1.565	0.444	0.43	0.03	0.12	0.02
Heavy black foam	0.253	0.024	15.83	1.38	1.49	0.10
Light black foam	0.187	0.009	4.94	0.57	0.24	0.03
Blue foam	0.054	0.022	11.49	0.77	4.76	0.34
Yellow foam	0.036	0.023	11.98	0.31	7.87	0.92
Flexible foam	0.032	0.015	15.18	2.24	6.95	0.97
Additive foam	0.056	0.034	11.38	1.22	6.99	0.85
PMMA	1.658	0.597	0.29	0.01	0.10	0.01
PVC	2.138	0.096	8.50	0.74	0.39	0.05
Polystyrene	1.559	0.510	12.05	1.21	3.95	0.44
Polypropylene	1.315	0.266	9.55	1.35	1.77	0.21
ABS	1.600	0.494	10.30	0.90	3.18	0.48

TABLE 4.20: Arapahoe test results.

Sample number	Initial sample weight	Initial filter weight	Burned sample weight	Filter & smoke weight	Decharred sample weight	Total amount burned	Smoke weight	Char weight	% Smoke based in weight loss	% Char	% Smoke based in In. weight
1	0.83413	0.40738	0.41081	0.40953	0.40062	0.43351	0.00215	0.01019	0.496	2.351	0.26
2	0.84256	0.40691	0.41406	0.40938	0.40149	0.44107	0.00247	0.01257	0.560	2.85	0.29
3	0.83917	0.40712	0.40244	0.40987	0.38885	0.45032	0.00275	0.01359	0.611	3.018	0.33
4	0.85107	0.40792	0.42852	0.41016	0.42011	0.43096	0.00224	0.00841	0.520	1.951	0.26
5	0.84035	0.40632	0.40965	0.40832	0.39857	0.44178	0.00200	0.01108	0.453	2.508	0.24
6	0.83349	0.40677	0.40766	0.40854	0.39537	0.43812	0.00177	0.01229	0.404	2.805	0.21

a" - PLYWOOD

1	0.66671	0.40736	0.24501	0.41142	0.22099	0.4217	0.00406	0.01404	0.963	3.15	0.61
2	0.66735	0.40812	0.22965	0.41237	0.21632	0.43385	0.00425	0.01718	0.980	3.81	0.64
3	0.67097	0.40673	0.23151	0.4118	0.21806	0.43946	0.00507	0.01345	1.154	2.97	0.76
4	0.67136	0.40653	0.25594	0.41116	0.24097	0.41542	0.00463	0.01497	1.115	3.48	0.69
5	0.66934	0.40729	0.23823	0.41165	0.22017	0.43111	0.00436	0.01806	1.011	4.02	0.65
6	0.68007	0.40717	0.2787	0.41149	0.21972	0.40137	0.00432	0.00898	1.076	1.95	0.64

b" - PINEWOOD

1	0.38751	0.40812	0.10198	0.41015	0.09688	0.29063	0.00203	0.0051	0.698	1.75	0.52
2	0.36312	0.40639	0.0859	0.40858	0.0814	0.28172	0.00219	0.0045	0.777	1.60	0.60
3	0.37147	0.40719	0.09046	0.40947	0.08586	0.28561	0.00228	0.0046	0.798	1.61	0.72
4	0.37596	0.40692	0.09119	0.40866	0.08599	0.28997	0.00174	0.0052	0.600	1.79	0.46
5	0.38335	0.40747	0.07939	0.4093	0.07379	0.30956	0.00183	0.0056	0.591	1.81	0.48
6	0.37991	0.40735	0.12227	0.40937	0.11777	0.26214	0.00202	0.0045	0.771	1.72	0.53

c" - FIBREBOARD

TABLE 4.20: Arapahoe test results (continued).

Sample number	Initial sample weight	Initial filter weight	Burned sample weight	Filter & smoke weight	Decharred sample weight	Total amount burned	Smoke weight	Char weight	% Smoke based in weight loss	% Char	% Smoke based in In. weight
1	1.57230	0.40712	1.11118	0.40915	1.10916	0.46314	0.0020	0.0020	0.441	0.428	0.13
2	1.55153	0.40811	1.10781	0.4103	1.05805	0.49348	0.0024	0.0020	0.481	0.396	0.15
3	1.56637	0.40739	1.14678	0.40902	1.14503	0.42134	0.0017	0.0017	0.403	0.391	0.11
4	1.56348	0.40667	1.13303	0.40869	1.13116	0.43232	0.0020	0.0019	0.457	0.438	0.13
5	1.56475	0.40693	1.14747	0.40843	1.14559	0.41916	0.0015	0.0019	0.356	0.451	0.10
6	1.57153	0.40727	1.13748	0.40926	1.13588	0.43565	0.0019	0.0016	0.432	0.368	0.12

d" - HARDBOARD

1	0.25301	0.40812	0.22882	0.41178	-	0.02439	0.00368	-	15.00	-	1.45
2	0.25208	0.40731	0.22811	0.41125	-	0.02397	0.00394	-	16.44	-	1.56
3	0.25239	0.40791	0.22823	0.41152	-	0.02416	0.00361	-	14.94	-	1.43
4	0.25294	0.40687	0.22903	0.41023	-	0.02391	0.00356	-	14.89	-	1.41
5	0.25333	0.40612	0.23036	0.41034	-	0.02297	0.00422	-	18.37	-	1.67
6	0.25314	0.40778	0.22969	0.41135	-	0.02345	0.00359	-	15.31	-	1.42

e" - HEAVY BLACK FOAM

1	0.18555	0.40837	0.17695	0.40879	-	0.00860	0.00039	-	4.535	-	0.21
2	0.19123	0.40792	0.18192	0.40845	-	0.00931	0.00053	-	5.693	-	0.28
3	0.19037	0.40734	0.1312	0.4078	-	0.00917	0.00046	-	5.018	-	0.24
4	0.18625	0.40681	0.17722	0.4073	-	0.00903	0.00049	-	5.426	-	0.26
5	0.18423	0.40752	0.17548	0.40794	-	0.00875	0.00042	-	4.8	-	0.23
6	0.18579	0.40713	0.1771	0.40749	-	0.00869	0.00036	-	4.143	-	0.19

f" - LIGHT BLACK FOAM

TABLE 4.20: Arapahoe test results (continued).

Sample number	Initial sample weight	Initial filter weight	Burned sample weight	Filter & smoke weight	Decharred sample weight	Total amount burned	Smoke weight	Char weight	% Smoke based in weight loss	% Char	% Smoke based in In. weight
1	0.05417	0.40712	0.0325	0.40955	-	0.02167	0.00243	-	11.21	-	4.49
2	0.05321	0.40635	0.03138	0.40909	-	0.02183	0.00274	-	12.55	-	5.15
3	0.05293	0.40803	0.03055	0.41038	-	0.02235	0.00235	-	10.51	-	4.44
4	0.05438	0.40691	0.03129	0.40974	-	0.02309	0.00283	-	12.26	-	5.20
5	0.05395	0.40737	0.03208	0.40979	-	0.02187	0.00242	-	11.07	-	4.49
6	0.05406	0.40745	0.03131	0.41004	-	0.02275	0.00259	-	11.38	-	4.79

g" - BLUE FOAM

1	0.03596	0.40732	0.01229	0.41018	-	0.02367	0.00286	-	12.08	-	7.95
2	0.03506	0.40704	0.01303	0.41066	-	0.02203	0.00262	-	11.89	-	7.47
3	0.03398	0.40695	0.00942	0.40976	-	0.02456	0.00281	-	11.45	-	8.27
4	0.04143	0.40621	0.02009	0.40884	-	0.02134	0.00263	-	12.32	-	6.35
5	0.03413	0.40733	0.0112	0.41007	-	0.02293	0.00274	-	11.93	-	8.38
6	0.03253	0.40656	0.00908	0.40942	-	0.02345	0.00286	-	12.21	-	8.79

h" - YELLOW FOAM

1	0.03167	0.40592	0.0171	0.40813	-	0.01457	0.00221	-	15.17	-	6.98
2	0.03325	0.40631	0.01824	0.40903	-	0.01501	0.00272	-	18.12	-	8.18
3	0.03214	0.40667	0.01738	0.40882	-	0.01476	0.00215	-	14.56	-	6.69
4	0.03192	0.40731	0.0174	0.40981	-	0.01451	0.0025	-	17.23	-	7.83
5	0.03134	0.40712	0.01689	0.40914	-	0.01445	0.00202	-	13.98	-	6.44
6	0.03216	0.40679	0.01717	0.40859	-	0.01499	0.0018	-	12.01	-	5.60

i" - FLEXIBLE FOAM

TABLE 4.20: Arapahoe test results (continued).

Sample number	Initial sample weight	Initial filter weight	Burned sample weight	Filter & smoke weight	Decharred sample weight	Total amount burned	Smoke weight	Char weight	% Smoke based in weight loss	% Char	% Smoke based in In. weight
1	0.05667	0.40637	0.02265	0.41035	-	0.03402	0.00398	-	11.70	-	7.02
2	0.05455	0.40792	0.01939	0.41218	-	0.03516	0.00426	-	12.12	-	7.81
3	0.055671	0.40638	0.01999	0.41015	-	0.03568	0.00377	-	10.57	-	6.77
4	0.05493	0.40694	0.02178	0.41134	-	0.03315	0.0044	-	13.27	-	8.01
5	0.05672	0.40708	0.02180	0.41087	-	0.03492	0.00379	-	10.85	-	6.68
6	0.05712	0.40714	0.02410	0.41037	-	0.03302	0.00323	-	9.78	-	5.65

j" - ADDITIVE FOAM

1	1.65305	0.40738	1.05731	0.40914	-	0.59574	0.00176	-	0.296	-	0.11
2	1.6605	0.40575	1.06139	0.40742	-	0.59111	0.00167	-	0.283	-	0.10
3	1.6545	0.40578	1.05452	0.40742	-	0.59998	0.00164	-	0.274	-	0.10
4	1.6684	0.40638	1.07046	0.40822	-	0.59794	0.00184	-	0.307	-	0.11
5	1.64065	0.40736	1.04354	0.40908	-	0.59711	0.00172	-	0.288	-	0.10
6	1.66938	0.40631	1.07158	0.40802	-	0.5978	0.00171	-	0.286	-	0.10

k" - PMMA

1	2.13639	0.40913	2.05523	0.41830	-	0.10371	0.00917	-	8.84	-	0.46
2	2.09452	0.40137	1.99562	0.40993	-	0.0989	0.00856	-	8.66	-	0.41
3	2.09181	0.40113	1.99857	0.40997	-	0.09324	0.00884	-	9.48	-	0.42
4	2.10484	0.40675	2.01807	0.41318	-	0.08677	0.00643	-	7.41	-	0.31
5	2.20139	0.40174	2.10798	0.40986	-	0.09341	0.00812	-	8.69	-	0.37
6	2.19907	0.40221	2.09771	0.41024	-	0.10136	0.00803	-	7.92	-	0.37

l" - PVC

TABLE 4.20: Arapahoe test results (continued).

Sample number	Initial sample weight	Initial filter weight	Burned sample weight	Filter & smoke weight	Decharred sample weight	Total amount burned	Smoke weight	Char weight	% Smoke based in weight loss	% Char	% Smoke based in In. weight
1	1.56382	0.40913	1.04421	0.46851	-	0.51961	0.05938	-	11.43	-	3.80
2	1.56535	0.40376	1.03830	0.46345	-	0.52705	0.05969	-	11.33	-	3.81
3	1.57017	0.40151	1.06309	0.46321	-	0.50708	0.0617	-	12.17	-	3.93
4	1.56106	0.40179	1.07232	0.4547	-	0.48874	0.05291	-	10.83	-	3.39
5	1.60137	0.40441	1.06913	0.48031	-	0.53224	0.07590	-	14.26	-	4.74
6	1.48903	0.40613	1.00315	0.46573	-	0.48588	0.0596	-	12.27	-	4.00

m" - POLYSTYRENE

1	1.34403	0.41368	1.07971	0.43507	-	0.26432	0.02141	-	8.10	-	1.59
2	1.29496	0.40195	1.01557	0.42445	-	0.27939	0.0225	-	8.05	-	1.74
3	1.28818	0.40813	1.05995	0.43383	-	0.22823	0.0257	-	11.26	-	2.00
4	1.34068	0.40549	1.05635	0.43269	-	0.28433	0.0272	-	9.57	-	2.03
5	1.35167	0.40615	1.1106	0.42885	-	0.24107	0.0227	-	9.42	-	1.68
6	1.27346	0.40267	0.97475	0.43526	-	0.29871	0.03259	-	10.91	-	2.56

n" - POLYPROPLYNE

1	1.59813	0.40316	1.06316	0.46437	-	0.53497	0.06121	-	11.44	-	3.83
2	1.61406	0.40728	1.09651	0.45798	-	0.51755	0.05070	-	9.8	-	3.14
3	1.58547	0.40397	1.06714	0.4550	-	0.51833	0.05103	-	9.85	-	3.22
4	1.60615	0.40812	1.19801	0.44942	-	0.40814	0.0413	-	10.12	-	2.57
5	1.71345	0.40653	1.18821	0.45438	-	0.52524	0.04785	-	9.11	-	2.79
6	1.48137	0.40414	1.02391	0.45675	-	0.45746	0.05261	-	11.50	-	3.55

o" - ABS

TABLE 4.21: Smoke variation with burning time.

Material	Burning time (sec)	% Smoke based on weight loss
White pine	20	1.32
	30 (standard)	1.12
	40	0.88
PVC	20	9.7
	30 (standard)	8.5
	40	6.8

For both materials, by increasing the time for burning the percentage smoke based on weight loss was decreased and vice versa.

4.1.3.2 The airflow time

The airflow time was varied while keeping the 30 seconds burning time constant. The results are presented in Table 4.22. For both materials tested (PVC and white pinewood), it seems there was no effect on the yield when the t_f was increased to 40 seconds. Decreasing the t_f to 20 seconds, both materials tested showed no significant change in the smoke yield.

TABLE 4.22: Smoke variation with airflow time.

Material	Airflow time (sec)	% Smoke based on weight loss
White pine	20	1.13
	30 (standard)	1.12
	40	1.15
PVC	20	7.9
	30 (standard)	8.5
	40	8.1

4.1.3.3 Rate of airflow

The airflow through the test chamber was also varied as shown in Table 4.23. The measured smoke yield was reduced by up to 10% for both materials with 50% of the airflow, but the effect was substantially less at 75% of the airflow.

TABLE 4.23: Smoke variation with airflow rate.

Material	Airflow % of standard	% Smoke based on: Weight loss	Initial weight
White pine	50	1.01	0.60
	75	1.10	0.68
	standard (120 l/min)	1.12	0.66
PVC	50	7.90	0.35
	75	8.22	0.36
	standard (120 l/min)	8.50	0.39

4.1.3.4 Sample position (distance from the burner)

The standard distance of 22 mm was also varied and the results obtained shown in Table 4.24. For both the white pine and the PVC, the weight loss was greater when the sample was 15 mm away from the burner, as the sample was almost completely immersed in the flame. The smoke yield based on weight loss increased but not significantly. When the distance increased to 30 mm, only a few millimetres of the sample were in the flame, but the results were not significantly different from the standard test.

TABLE 4.24: Smoke variation with sample position.

Material	Distance (mm)	% Smoke based on: Weight loss	Initial weight	Weight loss (gm)
White pine	15	1.21	0.82	0.61
	22 (standard)	1.12	0.66	0.45
	30	1.28	0.70	0.44
PVC	15	8.75	0.46	0.110
	22 (standard)	8.50	0.39	0.095
	30	8.10	0.35	0.082

4.1.3.5 Thickness of the sample

Double thickness was tested for two materials, PMMA and pinewood. Table 4.25 shows the results for the variation of the thickness. With doubling of the thickness, the pinewood produced a greater amount of smoke than with the single thickness, while the PMMA produced less smoke.

TABLE 4.25: Smoke variation with thickness.

Material	% Smoke based on: Weight loss	% Smoke based on: Initial weight	Weight loss (gm)
White pine			
Double thickness	2.38	0.57	0.24
Standard	1.12	0.66	0.45
PMMA			
Double thickness	0.24	0.04	0.51
Standard	0.29	0.10	0.60

4.2 Model Compartment Test

The experiments were carried out with each "fuel bed" for each set of burning conditions (Tables, Appendix II). D_o(Dynamic) was not measured in absence of corridor.

With the data logging system, data were recorded every five seconds[1]. At the end of each test, results of optical density, rate of smoke production and total smoke evolved are printed out every thirty seconds. This may result in some discrepancy between the peak values shown on graphs and those quoted in the tables, although they are generally in reasonable agreement.

[1] The data were stored on floppy disc which are held in the Department of Fire Safety Engineering, Edinburgh University.

For smoke, results are presented in terms of optical density and standardoptical density as calculated from equation 2.3 and 2.2. The calculation of D_o(static) and D_o(dynamic) was discussed in Section 2.1, as well as the rate of smoke production and the total quantity of smoke. These are all presented in Table 4.26.

4.2.1 Smoke yield

4.2.1.1 Free burning

It was found that with cribs, the values calculated for D_o(static) were similar to D_o as obtained in the EU smoke chamber. For PMMA, it was about a factor of 2 greater than D_o from EU chamber. Polypropylene behaved quite differently giving D_o ~3.4 ob.m^3/gm, compared with 0.35 ob.m^3/gm (Table 4.2). The t_m was nearly the same for medium and large cribs, while for the small crib it was shorter. The t_m for plastics (PMMA and PP) was the same.

4.2.1.2 Crib fires within the firebox (no corridor)

With the small cribs, there was a clear trend towards increasing smoke yield as the ventilation was reduced from 40 to 10 cm (Table 4.26). The same phenomenon was noticed for the medium cribs. However, the yield of smoke from the large cribs was approximately the same for the 40 cm and 10 cm opening, while a significantly greater amount was detected for the 20 cm opening (Table 4.26). The flame was outside the box in these tests, but was more vigorous with 10 cm ventilation.

4.2.1.3 Crib fires within the firebox (with corridor)

No significant trends were observed which could be attributed unambiguously to the effect of corridor length. The variation of D_o-(static) and D_o(dynamic) with corridor length may not be significant,

TABLE 4.26: Fire compartment results.

Fuel bed	Condition of burning	Corridor length (m)	Flame	D (ob)	D_o (ob.m^3/gm) (static)	St. dev. ±	D_o (ob.m^3/gm) (dynamic)	St. dev. ±	t_m (min)	Max % CO	Max % CO_2	Min % O_2	Temp box (°C)	Temp corridor (°C)	Radiation (W/cm^2)	Rate of burning (gm/s)
Small crib	*FB	-	-	0.31	0.18	0.02	-	-	9.0	-	-	-	-	-	-	1.05
	B1/4	0	*F	1.54	0.92	0.08	-	-	7.5	4.11	17.26	1.16	887	-	4.37	1.63
	B1/2	0	F	0.59	0.35	0.01	-	-	9.0	3.75	9.16	10.76	825	-	3.39	1.23
	B1	0	F	0.32	0.19	0.01	-	-	8.0	1.94	7.16	12.86	660	-	2.26	1.30
	B1/4	1	-	1.46	0.87	0.11	0.09	0.01	9.0	1.24	9.15	11.19	823	390	1.00	1.27
		2	-	1.45	0.86	0.1	0.21	0.01	6.5	0.81	8.60	11.48	751	305	0.80	1.02
		4	-	-	-	-	0.13	0.02	-	0.34	7.60	14.62	793	195	0.65	1.26
	B1	1	-	0.41	0.24	0.03	0.08	0.02	6.5	0.21	6.54	14.10	635	345	0.79	1.34
		2	-	0.28	0.17	0.03	0.06	0.02	7.5	0.17	6.31	14.81	683	261	0.74	1.31
		4	-	-	-	-	0.03	0.005	-	0.15	5.97	15.31	586	209	0.55	1.48
Medium cribs	FB	-	-	0.68	0.17	0.06	-	-	14.0	-	-	-	-	-	-	1.87
	B1/4	0	F	2.98	0.76	0.09	-	-	9.0	4.87	16.81	1.53	900	-	3.37	3.35
	B1	0	F	1.11	0.28	0.03	-	-	11.5	0.61	11.71	8.90	779	-	3.39	3.15

TABLE 4.26: Fire compartment results (continued).

Fuel bed	Condition of burning	Corridor length (m)	Flame	D (ob)	D_0 (ob.m³/gm) (static)	St. dev. ±	D_0 (ob.m³/gm) (dynamic)	St. dev. ±	t_m (min)	Max % CO	Max % CO_2	Min % O_2	Temp box (°C)	Temp corridor (°C)	Radiation (W/cm²)	Rate of burning (gm/s)
Medium cribs	*B1/4	1	*F	1.96	0.47	0.06	-	-	9.5	1.64	13.19	8.92	847	603	2.71	3.20
		2	-	2.15	0.53	0.03	0.11	0.005	9.0	1.13	12.24	8.54	905	450	1.39	2.56
		4	-	-	-	-	0.18	0.01	-	1.07	11.56	8.50	916	297	0.75	2.97
	B1	1	F	0.91	0.23	0.04	-	-	10.5	0.32	10.09	10.90	786	412	1.68	3.45
		2	-	1.03	0.26	0.04	0.08	0.005	10.5	0.32	11.96	9.67	714	373	1.17	3.35
		4	-	-	-	-	0.10	0.02	-	0.30	11.74	9.63	788	285	0.73	2.68
Large cribs	FB	-	-	1.77	0.22	0.06	-	-	13.5	-	-	-	-	-	-	3.80
	B1/4	0	F	2.22	0.28	0.005	-	-	13.5	-	-	-	946	-	3.82	4.20
	B1/2	0	F	3.89	0.49	0.07	-	-	11.5	-	-	-	906	-	3.52	4.90
	B1	0	F	2.28	0.29	0.005	-	-	11.5	-	-	-	777	-	3.46	5.85
	B1/4	1	F	5.29	0.67	0.06	-	-	13.5	-	-	-	963	826	3.65	3.97
		2	F	4.40	0.57	0.10	-	-	12.5	-	-	-	962	611	2.49	3.77
	B1/2	1	F	5.44	0.67	0.11	-	-	11.5	-	-	-	861	730	3.69	5.22
		2	F	5.90	0.73	0.07	-	-	13.0	-	-	-	852	575	2.41	3.87
	B1	1	F	6.49	0.83	0.18	-	-	12.5	-	-	-	779	631	3.46	6.32
		2	F	6.33	0.80	0.04	-	-	13.5	-	-	-	768	539	1.87	5.95

TABLE 4.26: Fire compartment results (continued).

Fuel bed	Condition of burning	Corridor length (m)	Flame	D (ob)	D_O (ob.m^3/gm) (static)	St. dev. ±	D_O (ob.m^3/gm) (dynamic)	St. dev. ±	t_m (min)	Max % CO	Max % CO_2	Min % O_2	Temp box (°C)	Temp corridor (°C)	Radiation (W/cm^2)	Rate of burning (gm/s)
PMMA	*FB	-	-	0.49	0.48	0.09	-	-	14.5	-	-	-	-	-	-	0.33
	B1/4	0	*F	1.52	1.50	0.15	-	-	5.5	6.54	15.41	3.00	742	-	3.56	1.31
		1	F	1.22	1.20	0.20	-	-	5.0	1.47	11.75	9.63	762	494	1.73	0.80
		2	-	1.08	1.10	0.20	0.29	0.04	5.5	1.30	9.67	10.20	803	350	0.60	0.61
		4	-	-	-	-	0.40	0.03	-	1.30	8.25	10.41	772	231	0.55	0.61
	B1	1	-	-	-	-	0.24	0.05	-	0.14	7.29	12.49	604	404	0.73	0.67
		2	-	-	-	-	0.20	0.03	-	0.14	6.12	13.44	698	329	0.45	0.76
		4	-	-	-	-	0.23	0.02	-	0.10	5.33	14.51	529	196	0.43	0.66
Polypropylene	FB	-	-	1.13	3.43	0.45	-	-	14.5	-	-	-	-	-	-	0.24
	B1/4	0	F	1.30	3.95	0.37	-	-	6.5	1.52	10.36	5.75	715	-	3.03	0.26
		1	F	1.06	3.18	0.1	-	-	6.5	1.42	7.18	11.05	727	267	0.85	0.44
		2	-	1.69	5.08	0.49	1.18	0.21	8.5	0.91	6.03	12.87	731	249	0.48	0.28
		4	-	-	-	-	1.16	0.13	-	0.30	4.70	15.19	716	187	0.29	0.29
	B1	2	-	-	-	-	1.34	0.11	-	0.29	3.99	14.14	672	221	0.37	0.34
		4	-	-	-	-	1.30	0.09	-	0.20	3.11	16.25	581	162	0.44	0.30

*FB = free burning; B = box; 1/4, 1/2, 1 = ventilation opening; F = flame outside the box or corridor.

although clearly the two types of measurement give considerably different values of D_o (Table 4.26). With the large cribs, there is a definite increase in D_o(static) with a 1 m corridor, but the 2 m corridor provided no significant change for one-quarter and full ventilation. However, the yield from one half ventilation rose monotonically. The flame here, again, was outside the one metre corridor for both medium and large cribs, but not for the small one. For the two-metre corridor, only the flame of the large cribs have been seen outside the corridor.

4.2.1.4 Plastics in the firebox (Table 4.26)

The plastics (PMMA and PP) burned as liquid pool fires. The yield of smoke from PMMA at one quarter ventilation was a factor of three greater than that from free burning, but the presence of the corridor was found to have only a small effect (~30% reduction for 2 m). On the other hand, the increase in smoke from PP with one quarter ventilation was only 15% over that from free-burning, and a two metre corridor increased this by a further 25%, giving a value of D_o(static) ~15 times greater than that measured in the EU smoke chamber. As with wood crib fires, D_o(dynamic) was found to be very much less than D_o(static) for both PMMA and PP. The t_m was nearly the same, either in the box only or with the corridor for PMMA, while for PP the test with 2-metre corridor took longer than one metre or box only to reach the maximum obscuration. For the plastics, and for both box only and with one metre corridor, the flame was outside the box or the corridor, respectively, while for the 2-metre corridor there was no flame outside the corridor.

4.2.2 *Temperature*

As discussed in paragraph 3.2.2.6, three thermocouples have been used to monitor the temperature at the end of the corridor, inside the box and the third for the ambient temperature. The ambient temperature varied between 10 and 25°C according to the season and the number of tests performed inside the test room. To overcome these differences, the duplicate tests were carried out at different times. As the temperature inside the box would be expected to depend on the nature and amount of the material and the restriction of the air (ventilation), the highest temperature recorded inside the box was for the large crib, while the lowest was for the small crib (Table 4.26).

The PMMA gave a higher temperature than the small crib or the PP. As for different ventilation, the highest temperature was the one recorded with the minimum ventilation. The temperature at the end of the corridor was found to be less than that measured inside the box, with a higher temperature for the lower ventilation. A higher corridor temperature may be associated with flaming combustion occurring in the corridor.

4.2.3 *Radiation*

Maximum radiation for the tests is given in Table 4.26, while the development of this radiation during the fire is presented in tables in Appendix II . A higher radiation is noticed with restricted ventilation for both the box alone, or with the corridor.

4.2.4 *Gas analysis*

The analysis of the gases, carbon monoxide, carbon dioxide and oxygen for all materials tested is presented in Table 4.26. For the small crib, the highest maximum concentration of CO and CO_2 were measured in tests involving the box only. With the corridor in place the apparent maximum concentration of CO and CO_2 (measured at the end of the corridor) was less, but this was due to experimental factors (which will be discussed in Section 5.1.4). There was a clear trend towards increasing the gas concentration as the ventilation was reduced from 40 to 10 cm.

The minimum oxygen concentration was found to decrease as the ventilation and the length of the corridor decreased. The medium cribs behaved to some extent in different ways from the small cribs. As the ventilation reduced from 40 to 10 cm, the CO and CO_2 concentration increased and O_2 decreased, but with the corridor in its place, with the measurement done at the end of the corridor, the effect was not significant on gas production (which will be discussed in Section 5.1.4).

PMMA and PP behaved in the same way as the small crib, i.e. the maximum concentration of CO and CO_2 increased as the ventilation was reduced and the length of the corridor decreased.

4.2.5 Weight loss (Table 4.26)

To provide a continuous record of weight loss throughout the fire, a load cell was used. Unfortunately, only large and medium crib weight losses were determined, as the sensitivity of the load cells was not enough to detect the small weight loss of small cribs, PMMA and PP, especially at the last stages of the tests. So the rate of burning of the small crib has been estimated using the optical density graphs and assuming that the rate of weight loss is constant during the period of smoke generation (Section 5.1.4). It was noticed that for both large and medium cribs the char residue left after flaming was ~20% of the initial weight. This has been taken as calculating the weight of the residue for the small crib. For the two plastics, no residue remained and the total weight loss was taken as the initial weight.

4.2.6 *Time*

Although the maximum obscuration was recorded for each experiment, each test was allowed to continue until 20 minutes had elapsed. The time to reach the maximum OD is presented in Table 4.26. It is important to report that there was a time lag in the system as the smoke accumulated within the test room. There was also a time delay (40 seconds) in the gas analysis (Figure 3.17).

The results show that the time taken to reach the maximum obscuration was greatest for the large crib, decreasing as the crib size was reduced. PMMA reached the maximum obscuration faster than PP. No significant effect for the length of the corridor on the t_m for wood cribs was evident.

4.2.7 *Ageing of the smoke*

Each test was left to continue for twenty minutes which allowed ageing of the smoke to be studied. The results are presented in Table 4.27, and show a decline of 13% to 47% from the maximum optical density. Figures 5.25 to 5.29 show that the 20 minutes for the test was not enough for complete ageing, but some tests were closer to complete ageing than others.

TABLE 4.27: Ageing of smoke.

Fuel bed	Condition of burning†	Length of corridor (m)	t_a (min)††	% Reduction of D
Small crib	FB	-	11	14
	B 1	0	12	19
		1	14	14
		2	14	17
	B 1/4	0	13	28
		1	11	24
		2	14	25
Medium crib	FB	-	6	14
	B 1	0	9	16
		1	10	14
		2	10	14
	B 1/4	0	11	24
		1	11	15
		2	11	23
Large crib	FB	-	7	13
	B 1	0	9	17
		1	8	18
		2	7	15
	B 1/2	0	9	20
		1	9	14
		2	7	16
	B 1/4	0	7	18
		1	7	13
		2	8	13
PMMA	FB	-	6	19
	B 1/4	0	15	24
		1	15	26
		2	15	23
PP	FB	-	6	23
	B 1	0	10	20
	B 1/4	0	14	32
		1	14	22
		2	12	47

†FB = free burning; B = crib enclosed in firebox; 1/2, 1/4 etc, ventilation opening (Figure 3.15).

††t_a = time between maximum obscuration and the end of the 20 minutes ($20 - t_m$).

4.3 Sources of error

There was a number of sources of error in each test. Most of these come from uncertainties in the experimental techniques.

4.3.1 Errors in the EU test

(a) The light detector was 5 cm above the floor of the chamber which meant that the beam light traversed only 220 cm of the 225 cm height of the chamber. However, most of the smoke will stratify in the upper part of the chamber and the error will be small (<±2% in the optical density).

(b) For the thermoplastics, some of the molten material was lost as it stuck to the sample holder. This would lead to an underestimate in D_o by ~3% (as a result of the actual weight loss being less than the recorded).

(c) The radiation was controlled by a voltage regulator (Variac) before each test, but there was no way to control it during the test. Any fluctuation in the electricity during the test would change the heat flux level. Also, the radiant heater would become hotter when the burning sample was opposite to it which would cause the heat flux to increase. It was a variation of ~3-4% only. This small variation will have little effect on the smoke yield (Section 5.1.2.7), except perhaps for fibreboard under non-flaming conditions, as it is very sensitive to changes in heat flux.

(d) After each test, the chamber was cleared of smoke, so that the residue could be collected for weighing. During this delay, the sample may continue to lose weight, especially for cellulosic materials. This would lead to higher weight loss and lower D_o. This was checked for fibreboard and white pine, by weighing the sample directly after the test finished and then left for three minutes (the maximum delay under experimental work to weigh the sample), and then weighed again. The results showed that fibreboard lost 5% of its direct reading after test, while for pine wood it was 3%. So for the cellulosic materials, the D_o was underestimated by 3-5%.

Equation 5.4 used to calculate the percentage error out of the above uncertainties. The error in D_o was ±5%. For most of the materials the error was less than the scatter in the results which ranged between 4 to 10%. This means that there were other factors which are very difficult or unpractical to account for (one example is the movement inside the laboratory).

4.3.2 NBS chamber

(a) The use of a valve to control the pressure in the chamber (measuring the pressure by manometer, Section 3.1.1.4) can lead to different conditions of test inside the chamber with some dilution to the smoke. There is no way to quantify the error in the present procedure from available data.

(b) The sensitive balance which was used was in a neighbouring building and it took about a minute to walk from the NBS chamber. This delay may have caused the sample to lose some weight.

(c) The recorded weight loss from the thermoplastics would be high because it was difficult to remove all the melted material from the sample holder and trough. This error can be estimated to be in the range of 2-4%.

The percentage error calculated by equation 5.4 is ±6 (for points (a) and (b) above, the uncertainties were estimated from the observation only). This error is well below (for most of the materials) the scatter in the results (Table 4.1) which was in the range of 4 to 15%.

4.3.3 Arapahoe test

(a) The sample size is very small and not easy to cut uniformly. The weight was normally within ±5% of the required value but any change in size or shape would lead to a difference in smoke yield.

(b) Some of the absorbed moisture may evaporate from the filter during the test. This was measured by a dummy run (no sample) under the standard specification and the difference in the filter weight was 3 to 5% (dependent on the humidity of the atmosphere). This led to the same uncertainty in underestimating the percentage smoke produced.

(c) To clean the sample from char (cellulosic material), a sandmill was used for 45 minutes. At the end of this time when the sample was being recovered, some fragments had broken off and were difficult to collect. This gave a higher weight loss, thus a lower percentage smoke based on weight loss.

Equation 5.4 was again used. The percentage error was ±7. This is also below the scatter which was in the range of 5 to 18%.

4.3.4 Model compartment method

The sources of error for dynamic measurement are discussed in Section 5.1.4.2. The following points (a) to (e), inclusive, relate to static measurement, while point (f) is common to dynamic and static measurements.

(a) The sensitivity of the load cell was not enough to detect the weight loss for small cribs, so the weight loss was estimated as 80% of the initial weight which is expected to be in error by no more than ±5%. Even for medium and large cribs, load cells were not sensitive enough to detect the last stages of weight loss at the end of the test. However, although each test was left to continue for 20 min from ignition, the weight loss was taken as the reading recorded at the same time as the maximum obscuration was reached. With the delay in the smoke detection because of the smoke movement, some samples may volatilize in this time and give a greater weight loss. Although the rate of burning at this stage was low, an error of about 4% could be expected.

(b) The vertical light beams were located near the four corners of the test room of 3 m height. This height was uneven, as the floor was not level, so that the length of the light beams was in the range of 2.90 to 2.97 m. As these had to be moved at the end of each series of tests, the length of the light beam was not strictly constant. Therefore, for simplicity of calculation, the height was taken as 3.0 m. This led to an underestimation of D_o by about 1-3%.

(c) Maximum obscuration of light recorded for each beam was at a different time (zero to 2 minutes delay), so that the average of the four light readings recorded within these two minutes was taken as the maximum obscuration for the purpose of calculating D_o. This led to uncertainty in D_o.

(d) Atmospheric and test room conditions: The test room was in an open windy farm area and heavily used in the training programme of the Scottish Fire Service Training School. Large fires are burnt in the chamber to produce smoke and heat as part of the training programme for firemen. These fires are put out by water application. The room was available for this project normally at the beginning of the week which meant that it had had a week-end to cool down. However, on occasions, the work had to be started less than 24 hours after it had been used by the College. The atmosphere and test room conditions affected the results as follows:

(i) When the room was used after less than 24 hours of previous use, it was humid, especially when the weather outside was calm. This may have led to some condensation of water vapour produced during the fires and thus higher D_o than under normal conditions.

(ii) Wind: Although during the test all the doors and openings were sealed, the effect of a high wind could still be noticed. The smoke accumulated non-uniformly, as observed by readings of smoke density in the four corners of the room (e.g. for one small crib test the optical density was recorded by two beams on one side, a and b (downwind) as 1.87 ob, while the beams on the other side, c and d, recorded only 1.54 ob (Table 4, Appendix II). This varied with wind speed and direction, and it was in the range of ±3% in calm weather to ±20% in windy conditions.

(iii) Rain: Fortunately, there were only a few rainy days during the work. The higher humidity may have led to condensation and a higher measured optical density.

(iv) Temperature: Different initial temperature existed in the test room on different days and in different seasons (5 to 25°C).

In addition, higher temperatures were produced during the day as experiments were carried out. To make allowance for the different temperatures and other weather conditions, each experiment was repeated twice or three times under different conditions. A difference of ~15% was normal between experiments done in the morning and afternoon.

(e) The space volume of the test room is 240 m^3.† Some times it was found that wood had been stored at one side of the room for subsequent use by the College. Its volume ranged between 1 and 3 m^3, but this would have increased D_0 by only 1%.

(f) Because several experiments were carried out every working day, the temperature inside the box was relatively high at the beginning of each test, except for the first experiment of the day. To overcome this problem at least partially, the box was left to cool for as long as possible between tests, and for the first experiment of the day 20 cc of methanol was burnt inside the box to warm it up and drive out any absorbed moisture.

The percentage of error from the uncertainties of the above points was calculated by equation 5.4. The error is ±12 to 24%. This is in agreement with the observed scatter of results which was in the range of 5 to 30%, although most lay within 10 to 20%.

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†It was assumed that the "void" above the false ceiling (see page 78) was filled with smoke. The volume of the "void" was about 1/6th of the total volume.

CHAPTER V

Discussion

In this chapter the results from the laboratory tests and the model compartment experiments are assessed individually and then compared with each other.

For the three small scale tests only smoke has been investigated and recorded either under the standard procedure or with the variation of the different parameters, while for the fire compartment there was a chance to make some other measurements, e.g. of gas concentrations which gave more data relevant to smoke production. The gases measured (CO and CO_2) contribute to the toxicity of the smoke.

5.1 Discussion of the tests

5.1.1 The NBS test

The results are presented in Table 4.1 and discussed in Section 4.1.1. The operating procedure for the NBS chamber calls for testing samples at their intended thickness (ASTM E662). For the purpose of this test, four of the materials were thicker than the recommended maximum 25 mm. These were cut to a 12.5 mm thickness for convenience, as this avoided too much compression when in the sample holder.

The specific optical density from the materials tested was higher under non-flaming than flaming conditions, except for four materials (heavy and light black foam, flexible and blue foam). As a different weight loss was recorded, the smoke potential was higher under a non-flaming than a flaming condition in nine materials out of eleven tested. The highest difference in smoke potential between flaming and non-flaming conditions was for the cellulosic materials (four times higher for pinewood to 60 times for fibreboard). Poor reproducibility in the weight loss for plastic foam materials (with some materials reaching a 25% difference) demonstrated the value of using smoke potential rather than the specific optical density.

5.1.2 The Edinburgh University chamber test

The reproducibility for D_s and D_o were very good in this test, the coefficient of variation being less than 10% for most materials. The reproducibility for weight loss was better than that of the NBS test (Table 4.2).

Although most of the materials tested here had the tendency to melt or drip, problems occurred only with PVC and PMMA. PVC was seen to bulge outward during the test, and part of the residue was dislodged when the sample was moved away from the heater at the end of the test. A piece of aluminium foil was placed to collect the material dropped. With regard to PMMA, melted material stuck to the sample holder, and the residue could be removed only if the furnace was first allowed to cool. This might have led to further volatilization before removing the residue. To check this assumption, the residue was left a long time in front of the heater after the test was finished. The loss in the weight was very small, so any volatilization during cooling time would have been negligible. The effect of varying the number of experimental parameters on D_o is discussed in the following section.

5.1.2.1 Position of smoke furnace inside the chamber (Table 4.3)

Figure 3.21 shows that positions "b" and "d" were the furthest away from the beam detector, while positions "a", "c" and "n" were nearly equidistant from the light beam. These arrangements seemed to have a small effect on smoke measurement at the early stages as a result of the different distances between the light beam and the furnace, while at the end of the test there seemed to be no effect on the measured amount of smoke produced. This means that a good mixing for smoke was achieved naturally, at least in the late stages of the test (Figure 5.1).

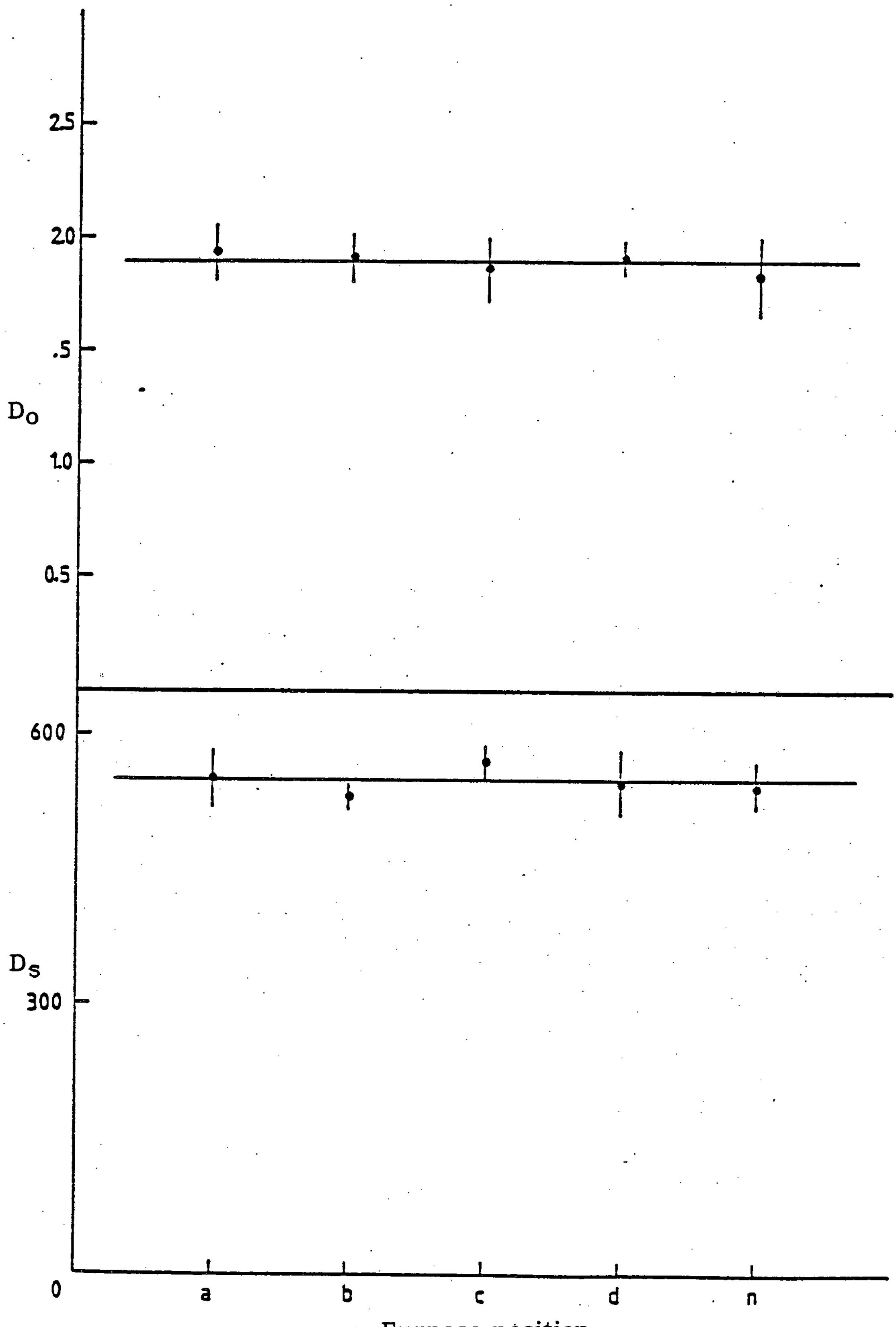

FIGURE 5.1: Effect of furnace position (fibreboard).

5.1.2.2 Effects of stirring the smoke (Table 4.4)

The purpose of these experiments was to observe the effect of the fan (stirring). Figure 5.2 shows that for both D_S and D_O there was no significant effect of the fan. It was noticed that when the fan was in position "R" (Figure 3.22) behind the light beam, the smoke production appeared to be less during the first few minutes. This is likely to be due to the fan displacing smoke from the line of the optical beam, particularly in the early stages when the amount of smoke was small. This effect was more significant with the fan at a height of 0.65 m than on the ground, as there is less smoke near floor level. So for any standard test which requires stirring the smoke by a fan, the fan should not be placed behind the light beam and not positioned too high but on the floor level.

5.1.2.3 Thickness of the sample

(a) Fibreboard

The difference in the results which was shown in Table 4.5 for the two thicknesses tested under flaming and non-flaming conditions, shows higher D_O for the thinner than for the thicker sample. This behaviour has been shown also from work of Shern (1967). This can be explained as for the thick materials, the formation of char reduces heat penetration, resulting in decomposition occurring at lower temperature towards the rear of the thick sample. Under these conditions less "tar" (which is a component of combustible volatiles) and more CO, CO_2 and water vapour are produced. Another factor may be the change in the structure and porosity of the material resulting from the method of preparation (Section 3.4.1.2.3).

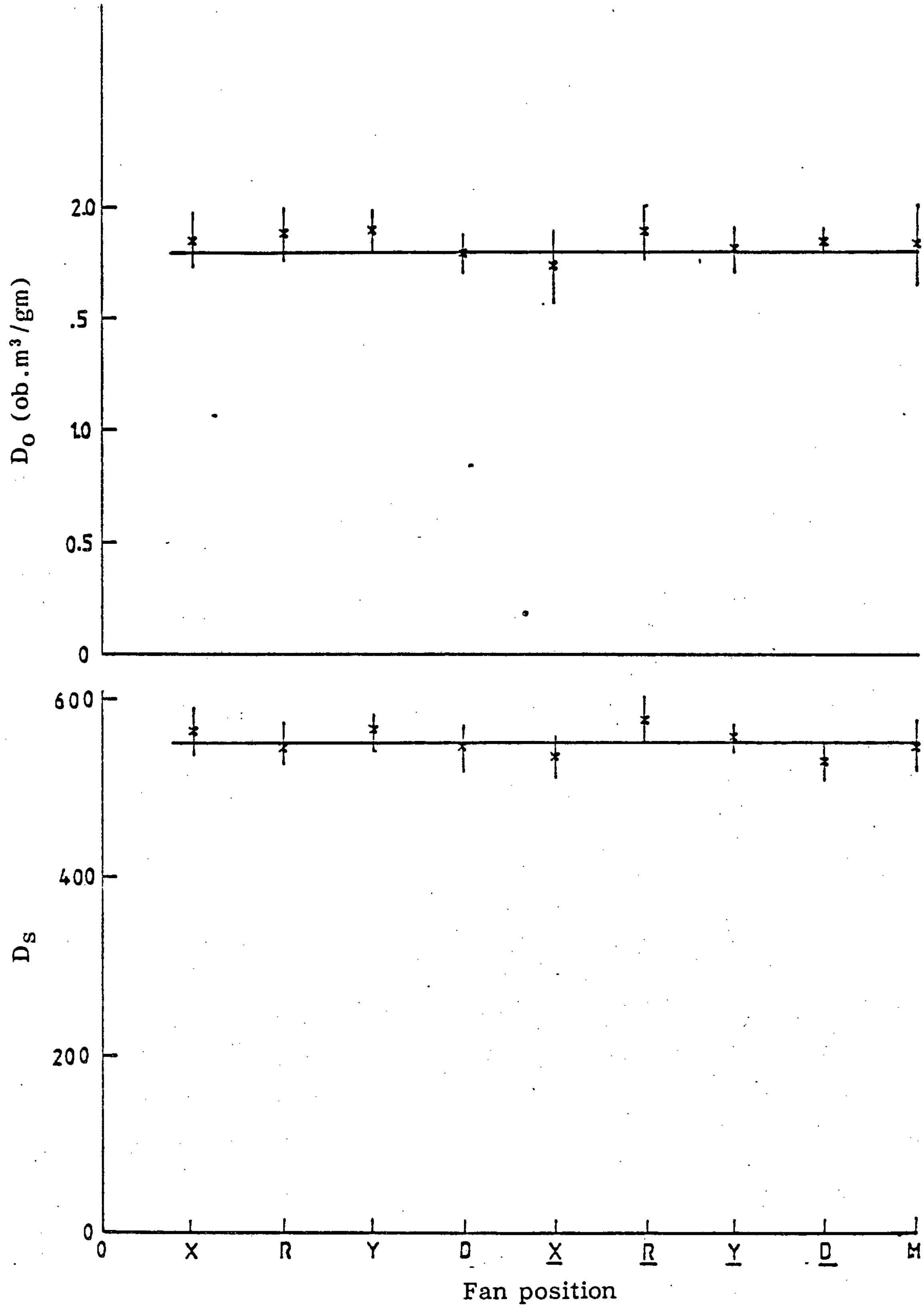

FIGURE 5.2: Effect of stirring the smoke.

(b) PMMA

Figure 5.3a and Table 4.6 show the results for D_s and D_o. D_o is independent of thickness for both flaming and non-flaming conditions, with an acceptable proportion between thickness and D_s (0.114 ± 0.01 ob m^3/gm per millimetre thickness for flaming and 0.025 ± 0.002 for non-flaming condition). Figure 5.3b shows that for the 5 and 6 mm thick samples, the time recorded for the first appearance (detection) of the smoke was about 6 minutes, while it was only 4 minutes for the sample of 3 mm thickness (non-flaming combustion). 50% of the maximum obscuration was recorded after 7 minutes from the beginning of the test for the 3 mm thick sample. The time was 14 minutes for 5 and 6 mm thick samples, and this might be due to the different thermal penetration as a result of the different thermal mass of the material. For flaming combustion, it was noticed that the time to 50% of the maximum obscuration is proportional to the thickness of the sample.

(c) Foam

The results here (Table 4.7 and 4.8) support the work of Seader *et al.* (1974). They recorded the independence of the smoke potential (D_o) of the sample thickness, although there is a difference in D_o for flexible foam under non-flaming condition (Figure 5.4). Additive foam and flexible foam (Figure 5.5) under flaming condition show, as expected for materials of low thermal inertia and low mass (low density), that smoke is produced very quickly and the test is completed within a short time. It was noticed that almost all the sample was burnt during the first few seconds, and only the edges were left to burn for a long time.

The results for foam and PMMA are in agreement with work by Hilado (1970) who also recorded a proportionality between thickness and the specific optical density.

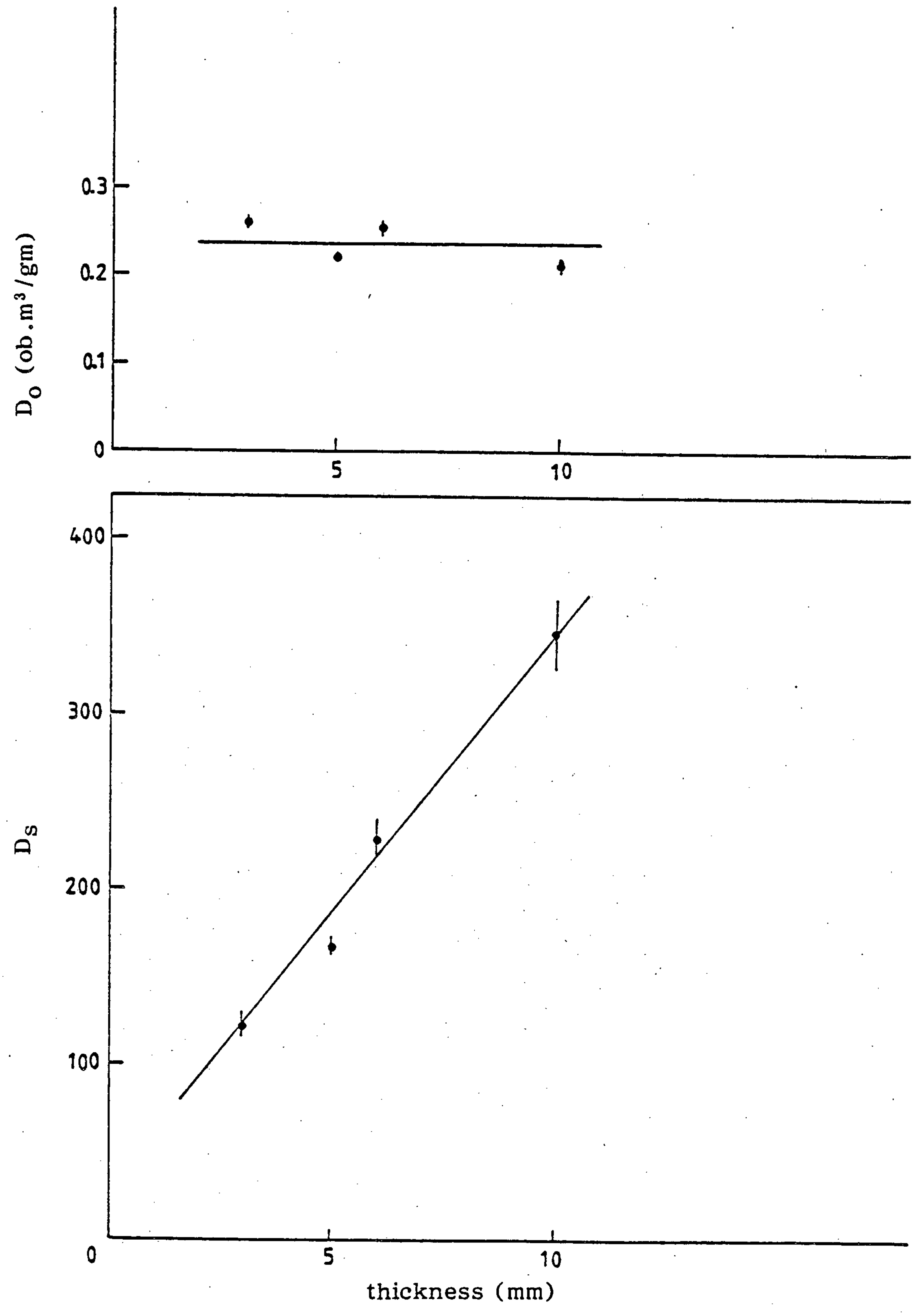

FIGURE 5.3a: Variation of D_s and D_o with different thicknesses of PMMA (flaming).

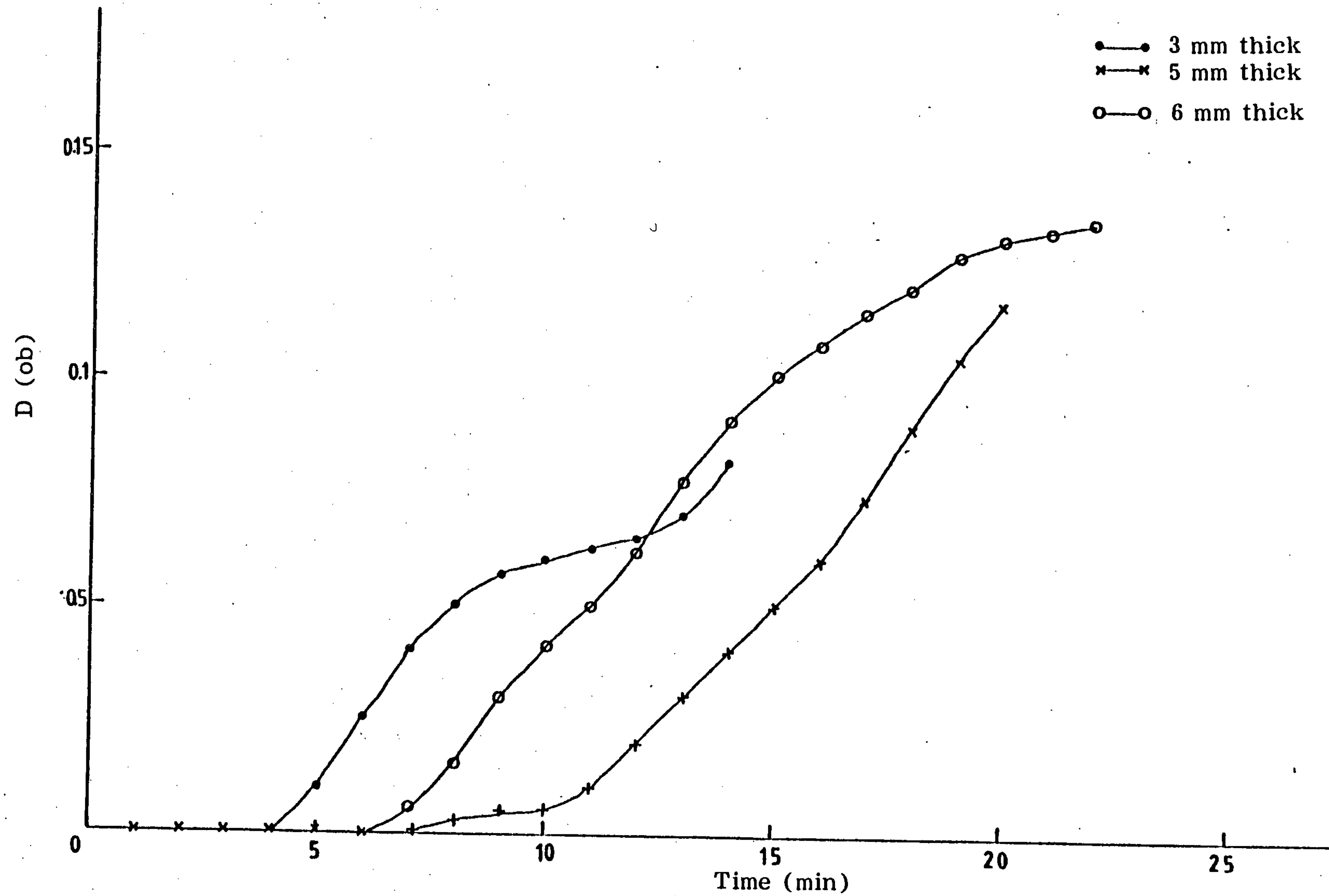

FIGURE 5.3b: Variation of time to smoke appearance with different thicknesses of PMMA.

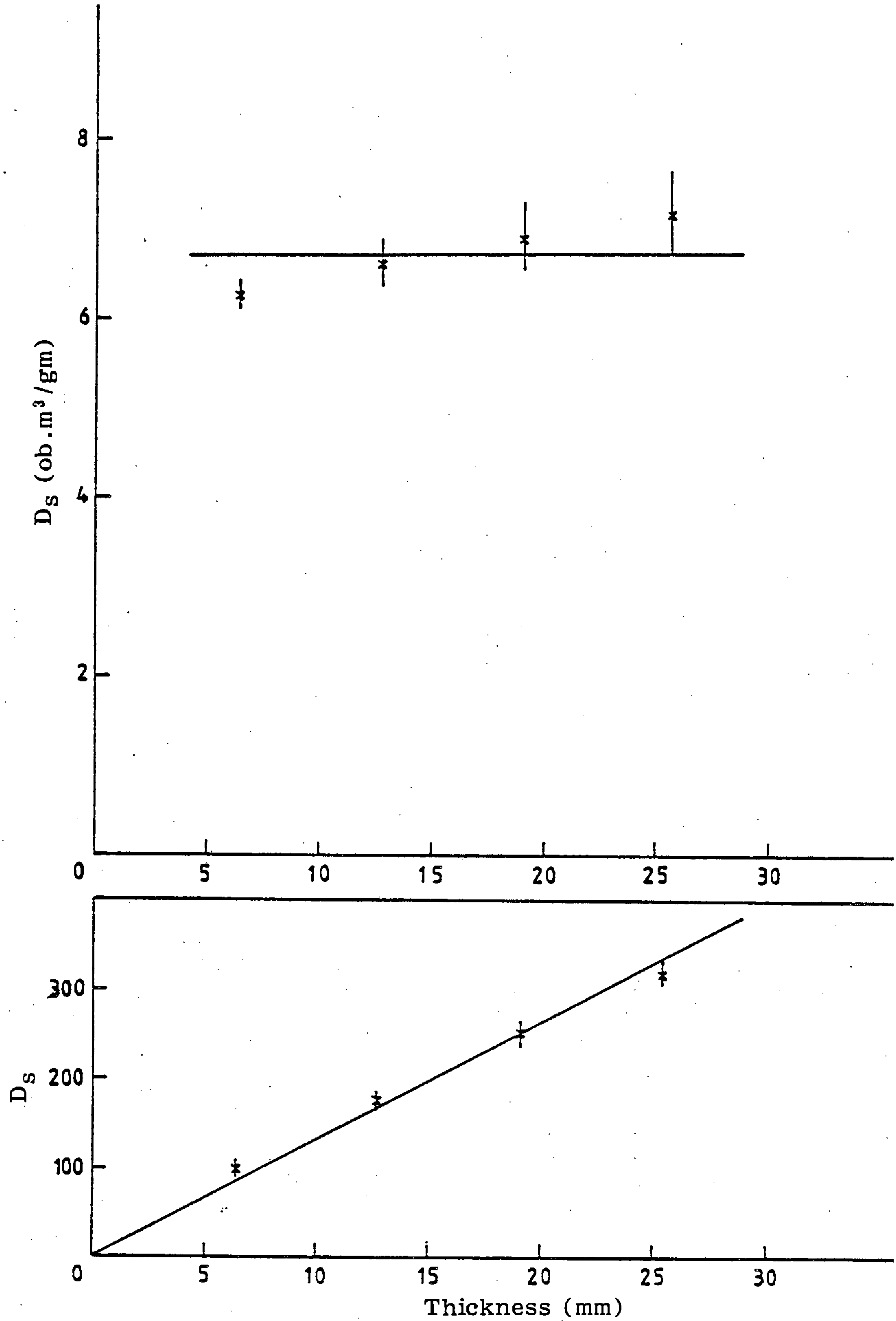

FIGURE 5.4: Variation of D_S and D_O with different thicknesses of flexible foam (non-flaming).

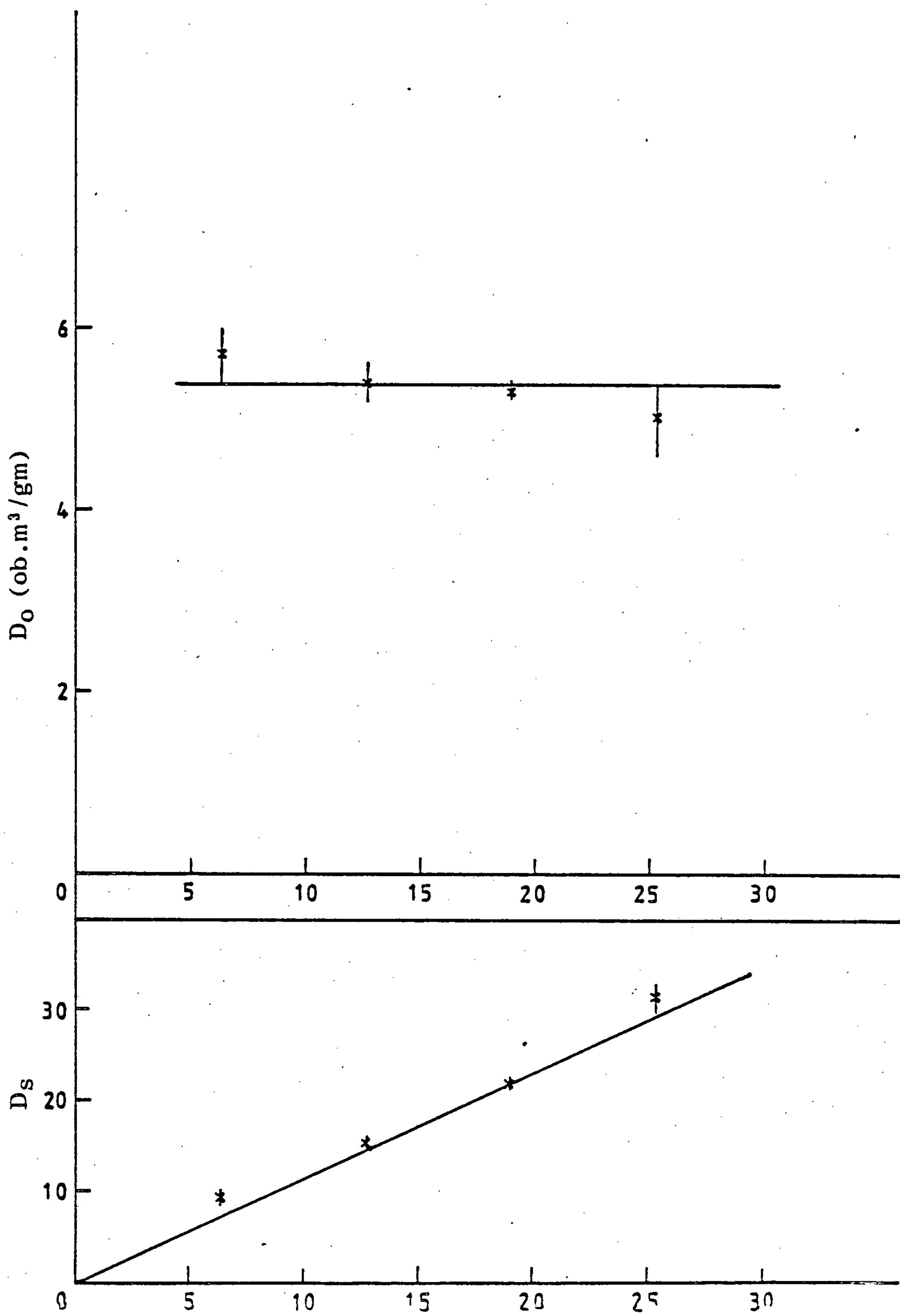

FIGURE 5.5: Variation of D_S and D_O with different thicknesses of flexible foam (flaming).

5.1.2.4 The effect of layers (same material)

There is either no effect or only a small one on smoke potential due to the layers for flexible polyurethane (Figure 5.6) or additive foams, as well as for PMMA. Fibreboard behaved differently, as a lower D_s and D_o were recorded for a single layer than for the double layer of equivalent thickness. This may be due to the effect of the rapid rise in temperature at the surface of the front layer because of an air gap between the layers.

As a result of the very quick rise in the surface temperature, a rapid release of smoke can be expected with regard to the thin layer, and thus the maximum obscuration is reached very rapidly, while the thicker layer may take a longer time to heat and thus produces the smoke more slowly than the thin layers. In this case, the smoke may continue for a long time after reaching the maximum obscuration. This is supported by the longer t_m (time to maximum obscuration) for one piece than for the double layer of equivalent thickness. Another explanation for these results, as the surface temperature rises quickly in the thin layer, more flammable volatiles and less char are produced, while for the thick layer a lower surface temperature means less flammable volatiles and more char.

5.1.2.5 Combination of two pieces (vertical or horizontal)

This test was carried out to check the effect of edges and joins in the material(s) on smoke production.

It appears that there is a difference between a single piece of fibreboard and the different configuration of two half pieces (Figure 5.7). For flaming combustion, there was no difference in D_o between the single piece and the combination of two pieces, although the weight

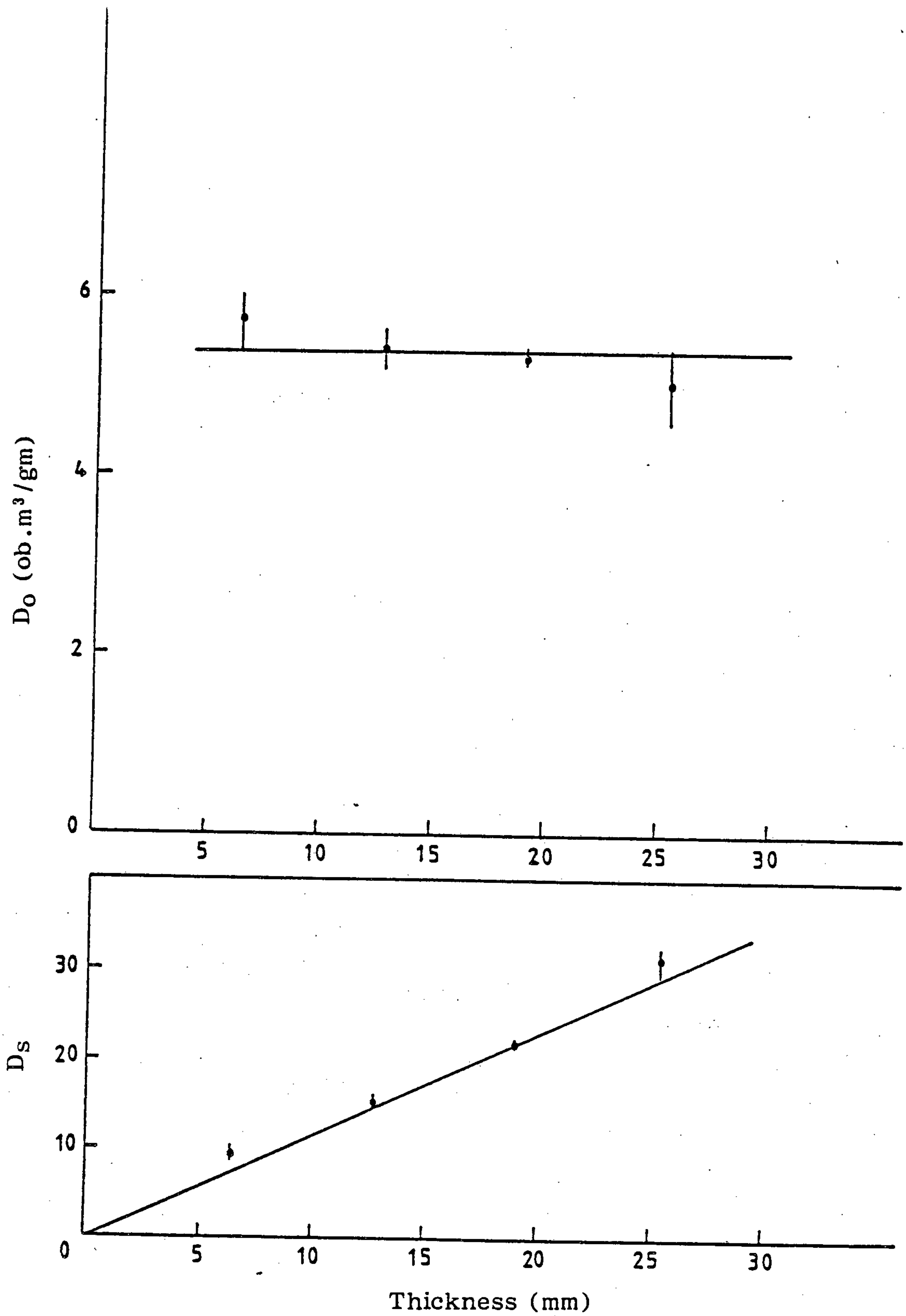

FIGURE 5.6: Variation of D_S and D_O with thickness by layer of the flexible foam.

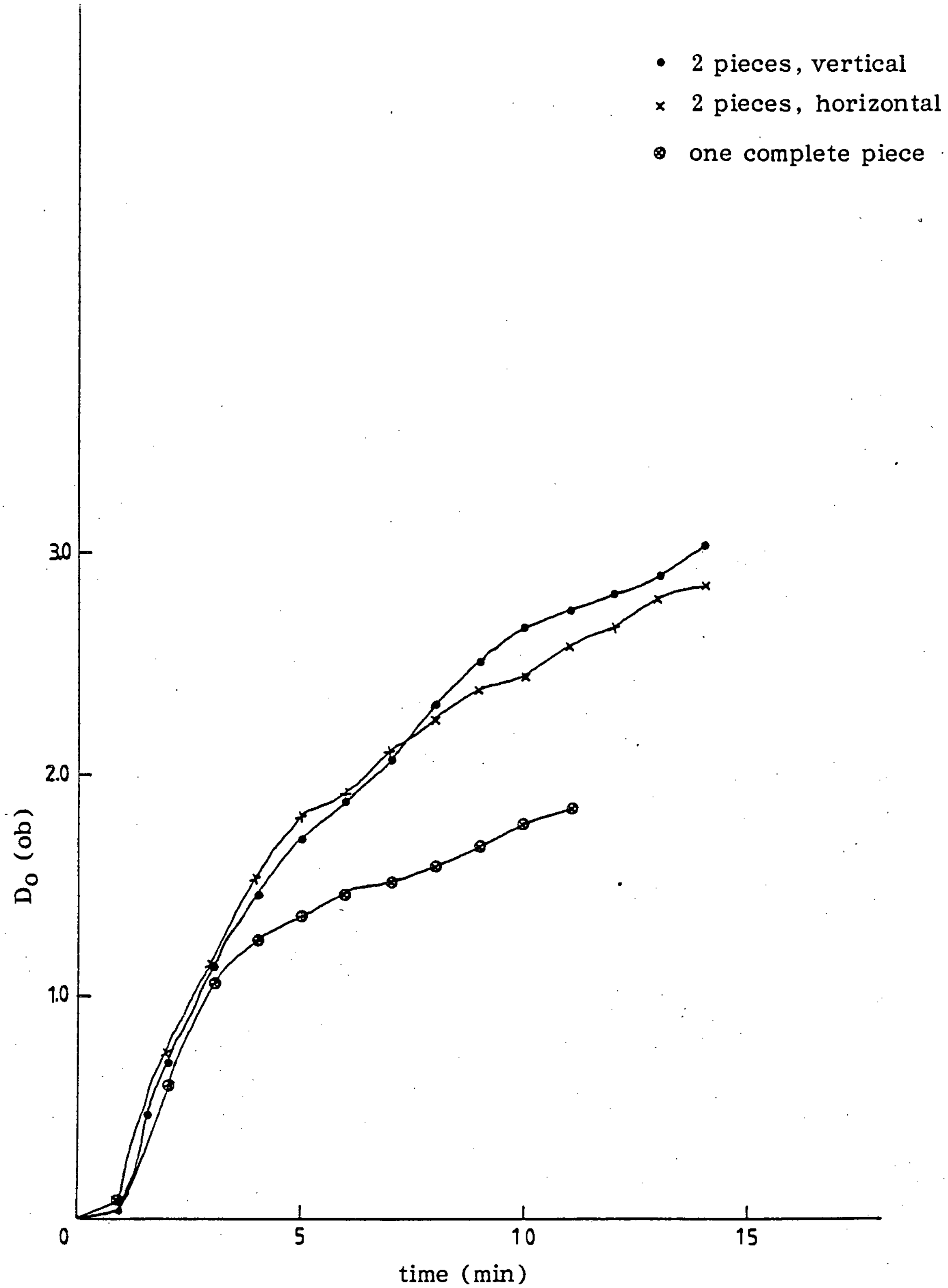

FIGURE 5.7: Effect of combination of two pieces of fibreboard on smoke yield.

loss was three times higher in the single piece than in the combination. The values of D_s were in the same proportion (Table 5.1).

TABLE 5.1: Effects of combination of two pieces of fibreboard on D_o.

Combustion	Arrangement	D_s	Weight loss (gm)	D_o ob.m^3/gm
Flaming	one single piece	30.7	14.51	0.09
	2 halves, vertical	9.8	4.59	0.09
	2 halves, horizontal	9.8	5.16	0.08
Non-flaming	one single piece	543	12.55	1.83
	2 halves, vertical	976	13.58	3.04
	2 halves, horizontal	879	13.09	2.84

Under non-flaming conditions, there was no significant difference in smoke potential between horizontal and vertical configuration, but there was a significant difference between these and a single piece for both D_s and D_o. This may be due to the effect of the edges which lead to more heat penetration giving rise to higher temperature and more flammable volatiles. For PMMA, no effect has been noticed on D_o as a result of testing two pieces of the sample. This is because the PMMA can easily be cut to give two pieces with smooth edges which fuse together when heated in the apparatus. Predicted D_o is calculated as follows for two different materials tested together, assuming an additive smoke production from each material.

Initial weight - weight of burnt sample = weight loss (gm)

Weight loss (F-B) x D_o (F-B) = D''' (ob.m^3) for Fibreboard in the combined sample.

Weight loss (PMMA) x D_o (PMMA) = D''' (ob.m^3) for PMMA in the combined sample.

$$\text{Predicted } D_o \text{ (ob.m}^3\text{/gm)} = \frac{D''' \text{ (FIB)} + D''' \text{ (PMMA)}}{\text{total weight loss (gm)}}$$

Table 5.2 shows the comparison of predicted D_o with measured D_o.

TABLE 5.2: Predicted and measured D_o from the combination of 2 materials.

Arrangement	Combustion	D_o measured ob.m^3/gm	D_o predicted ob.m^3/gm
1. Vertical, F-B + PMMA	F*	0.168	0.181
2. Horizontal, F-B (top) + PMMA	F	0.196	0.180
3. Horizontal, F-B + PMMA (top)	F	0.168	0.183
4 Vertical, F-B + PMMA	NF	0.710	0.681
5. Horizontal, F-B (top) + PMMA	NF	0.621	0.655
6. Horizontal F-B + PMMA (top)	NF	0.620	0.640

*F = Flaming; NF = Non-flaming

Good agreement between predicted and measured D_o can be seen in the table (5.2), as the difference between the predicted and the measured D_o was less than 10%. Rasbash and Pratt (1979/80) found when testing the combination of two different materials under free burning conditions, that the predicted D_o agreed reasonably well with the experimental smoke potential, except in certain combinations, when one of the materials was unable to burn very effectively unless associated with an easily combustible material.

5.1.2.6 Separate layers of different materials

In reality, different materials are used together, one material on top and other(s) behind (e.g. wall lining), so the aim of this test was to demonstrate what effect this combination has on smoke yield.

In general, the measured smoke yield was less than predicted for samples consisting of layers of fibreboard and PMMA. Table 5.3 shows the comparison between the predicted and the measured D_O. The front layer shields the rear layer, as can be seen in the results with fibreboard in front (arrangement 4) as the weight loss of PMMA

TABLE 5.3: Smoke production of materials in combination.

	Combustion	D_O (ob.m^3/gm) measured	predicted
1. FIB†(12.7 mm) in front + PMMA	F*	0.167	0.207
2. FIB (12.7 mm) + PMMA in front	F	0.177	0.174
3. FIB (6.3 mm) in front + PMMA	F	0.196	0.213
4. FIB (12.7 mm) in front + PMMA	NF	1.687	1.891
5. FIB (12.7 mm) + PMMA in front	NF	0.619	1.110
6. FIB (6.3 mm) in front + PMMA	NF	0.460	0.540

† FIB = Fibreboard *F = Flaming; NF = Non-flaming

was only 1.5 gm (5% of the initial weight) compared with 32.6 gm (97%) when the PMMA was in front. Smoke production from the test is presented in Figure 5.8, which shows a long delay for smoke to be produced when the PMMA was in front (arrangement 5). This is due to the higher thermal inertia of PMMA compared with fibreboard, and also the fact that PMMA produces very little smoke under non-flaming conditions. This arrangement (5) shows the biggest difference between predicted and measured D_O, which may be due to the effect of PMMA working as a barrier. Thus, less heat was transferred to fibreboard leading to more char and fewer flammable volatiles. Some, but not too much degradation of the fibreboard was observed at the end of the test.

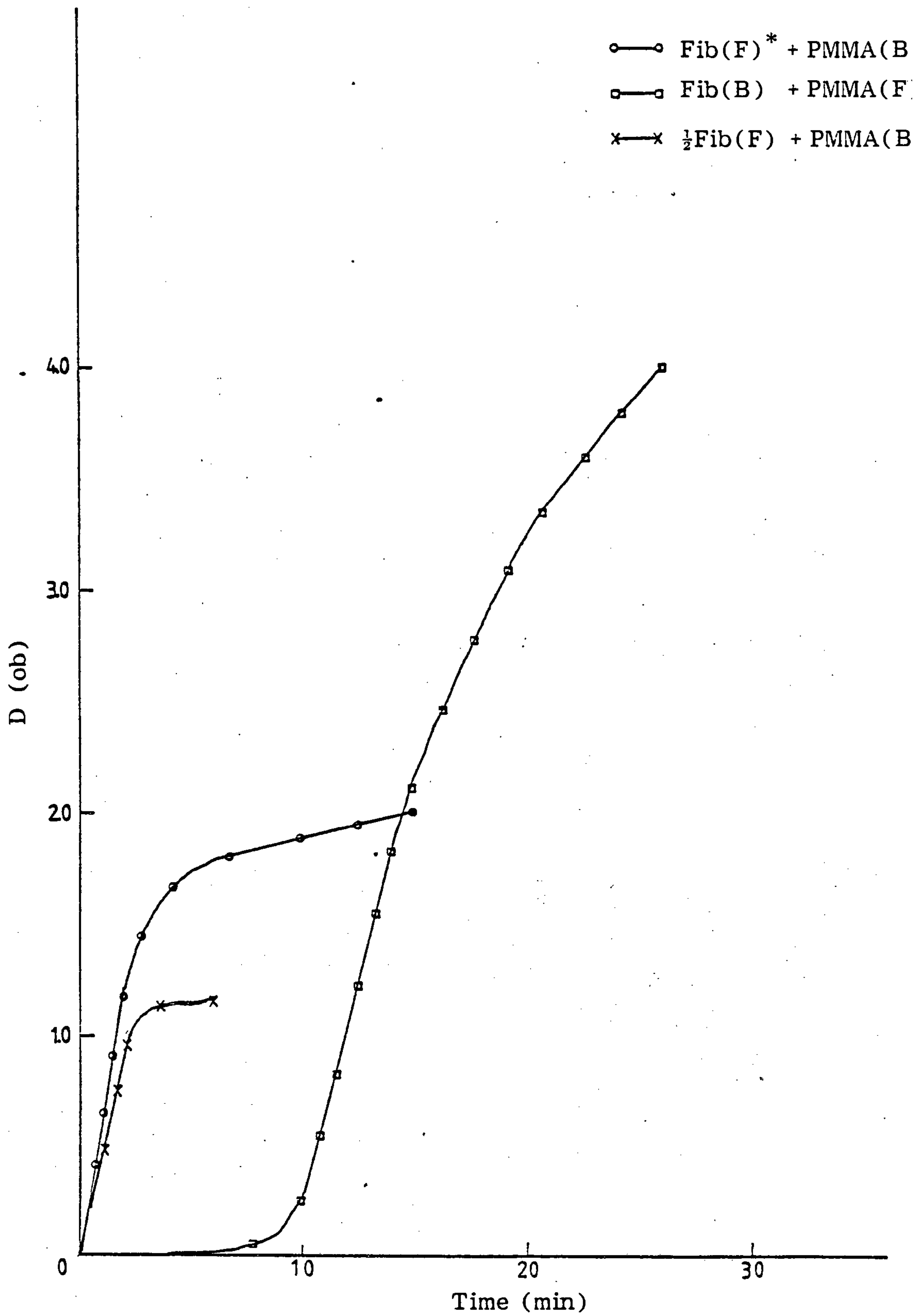

FIGURE 5.8: Optical densities of different layers of fibreboard (Fib) and PMMA.

*(F = Front, B = Back)

5.1.2.7 Variation of radiant heat flux

In general, for the four materials tested (fibreboard, PMMA, heavy black foam and white pine), the smoke production increased with the increase of the flux, under both flaming and non-flaming conditions. The time delay before appearance of volatiles decreased with the increase of the heat flux.

Fibreboard was tested under non-flaming conditions only (Table 4.15). The increase in D_O as a result of the increase of the radiation from 1.00 to 2.90 W/cm^2, was ~30%. To compare the yield of smoke from natural smouldering of fibreboard with that obtained under non-flaming conditions, a sample of the material was allowed to smoulder within the chamber until maximum obscuration was reached. The D_O was 1.21 ob.m^3/gm compared with 1.83 ob.m^3/gm with a flux of 2.5 W/cm^2. The percentage weight loss was 55 compared with 77 for a sample tested with flux of 2.5 W/cm^2. This lower D_O and per cent weight loss are due to the absence of any external heat source for the sample tested naturally. Thus a lower temperature in the decomposition zone resulted in producing volatiles with less flammable constituents. This experiment could not be repeated for the other materials as they do not support smouldering in isolation.

White pine wood under non-flaming conditions (Table 4.16) showed a sharp increase in D_O (15 times) and D_S with increasing flux from 1.0 to 3.0 W/cm^2. The weight loss showed the greater increase between 1.0 to 1.5 W/cm^2. It was noticed that between 2.5 and 3.0 W/cm^2, the increase in D_O was less (Figure 5.9a). These observations can be explained if the char forming reaction is important at low temperature (1.0 W/cm^2, which corresponds to a black body temperature of 375°C)[1]

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[1]These temperatures apply to conditions assuming that heat loss is only by radiation and to unit emissivity. The actual temperature will be significantly less.

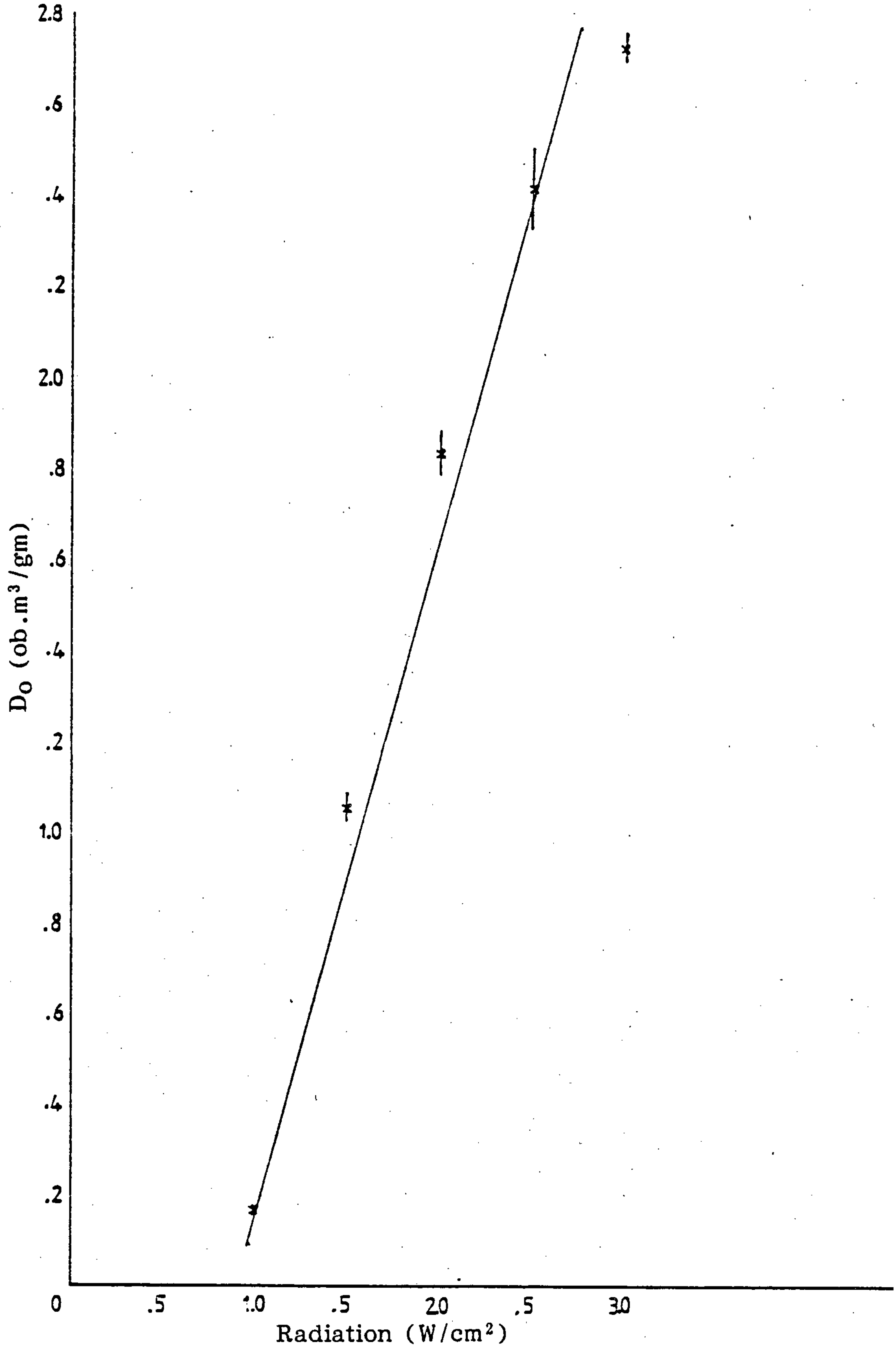

FIGURE 5.9a: Variation of D_O with radiation for white pine in EU test (non-flaming).

and the "tar forming" reaction is significant at higher temperature (>2.5 W/cm^2, corresponds to black body temperature of 570°C[1]). The char layer will protect the unaffected wood below. Under flaming conditions, white pine produced a very small amount of smoke at 1 W/cm^2, increasing by only a factor of four at 3 W/cm^2 (Figure 5.9b). The composition of the volatiles will change as the heat flux is increased, but of course the volatiles are burnt in the flame.

Chein and Seader (1974) recorded for α-cellulose with a different heat flux that the specific optical density increased with the increase of the flux till 2.5 W/cm^2. Above this level the increase in the flux had no effect on the specific optical density. This seems to be in agreement with the results of this project.

For PMMA, under non-flaming conditions and with a heat flux of 3.0 W/cm^2, auto-ignition occurred in one of the five tests that were carried out. The result from the test with auto-ignition was ignored. Generally, the increase in flux increased both D_S and D_O for flaming and non-flaming conditions (Figures 5.10 a and b), although the increase in D_O under non-flaming condition was less pronounced but continuous, as a result of the increase in weight loss with the increase of the flux. Madorsky (1964) found that when PMMA pyrolysed in a vacuum at a different temperature for 30 minutes, the percentage of volatilization was different, 38% at 268° to 74% at 318°C. With higher temperatures (500 to 1200°C), he studied the products of volatilization from pyrolysis of PMMA. The results refer to much higher temperatures than the ones used in this project (which is unlikely to be more than 400°C). At 500°C, the production of monomer ($C_5H_8O_2$) was 93% (as weight per cent of total volatiles), while at 800°C it was 80.5%.

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[1] see footnote on preceding page.

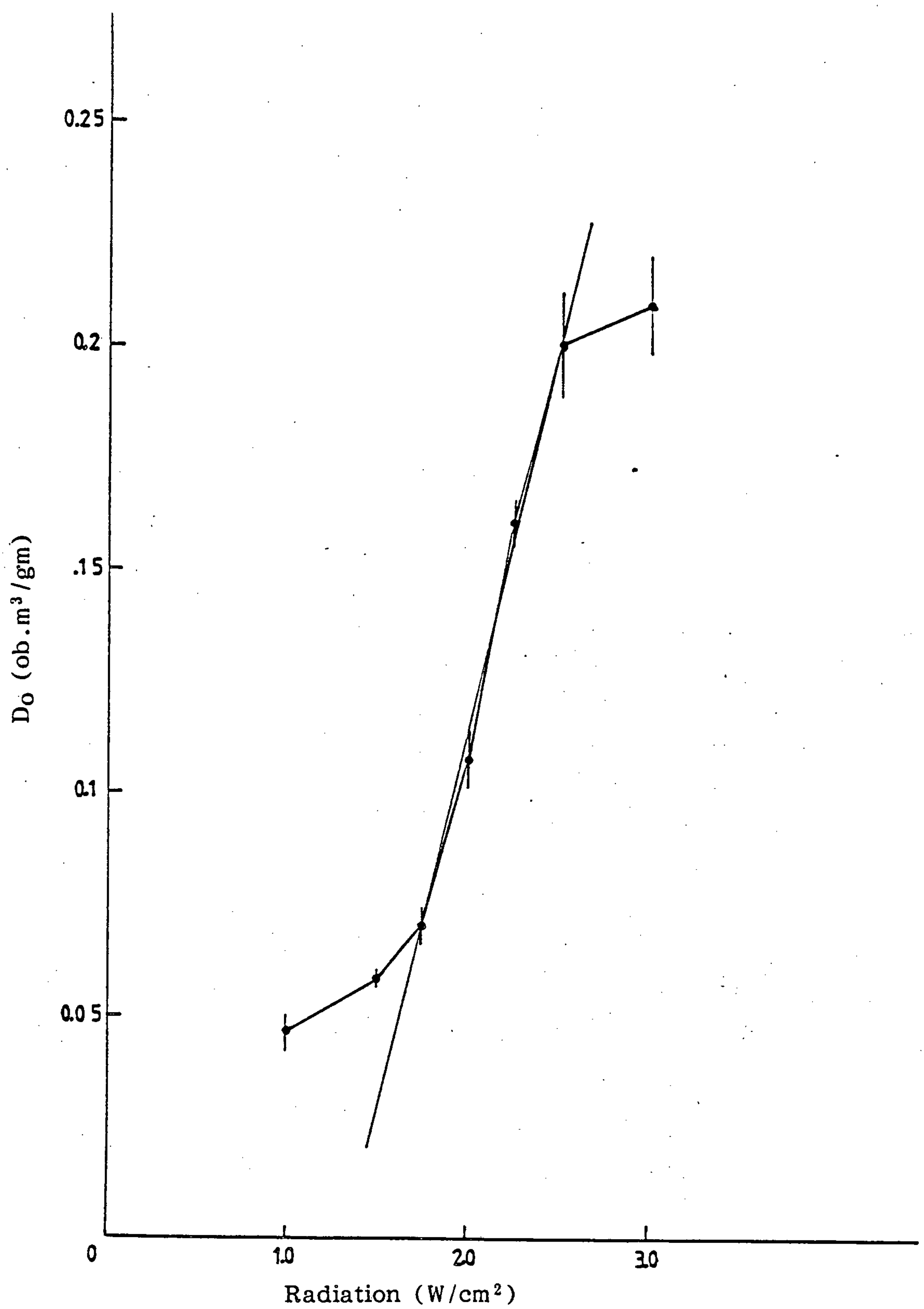

FIGURE 5.9(b): Variation of D_O with radiation for white pine in EU test (flaming).

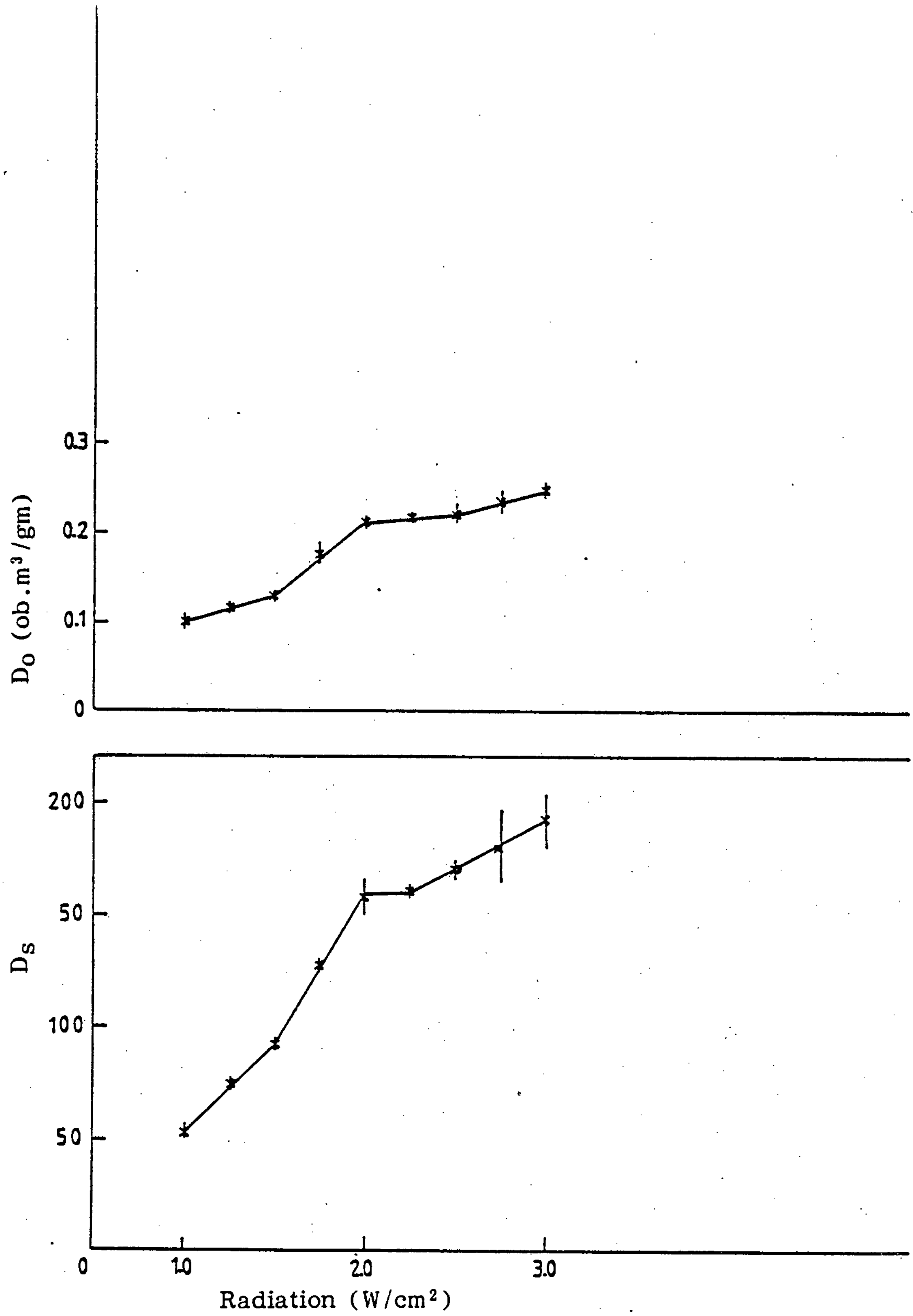

FIGURE 5.10(a): Variation of D_S and D_O with radiation for PMMA in EU test (flaming).

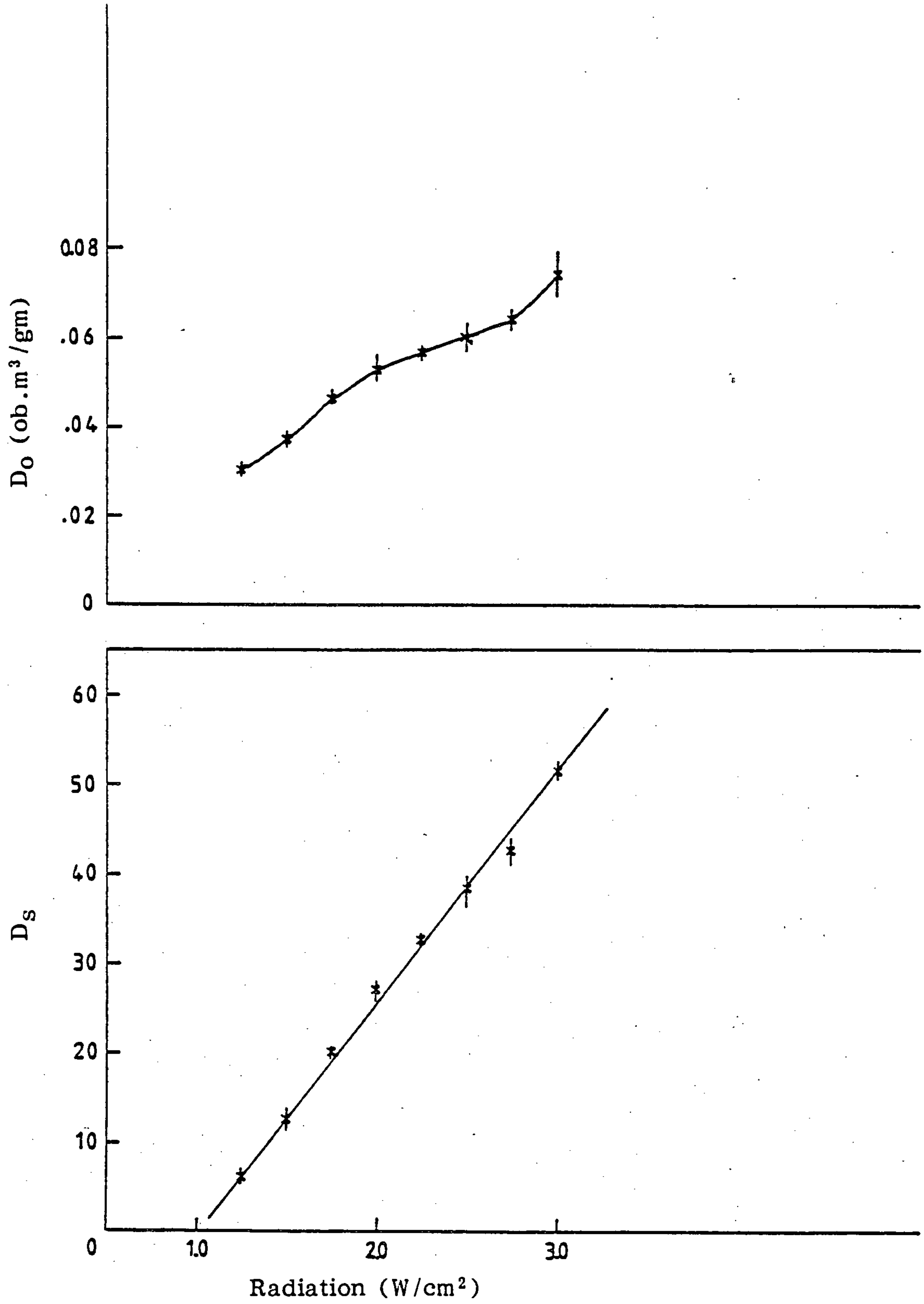

FIGURE 5.10(b): Variation of D_S and D_O with radiation for PMMA in EU test (non-flaming).

PMMA is the only material tested in the EU chamber which produced more smoke under flaming than non-flaming conditions. As a material which produces a high yield of monomer (91% to 98%, Cullis *et al.*, 1981), under non-flaming conditions only a small portion of the volatiles will condense to form "smoke" as they mix with the cooler air (unless the collection volume is small). Under flaming conditions, the smoke particles are generated in the gas phase as a result of incomplete combustion in the flame.

The smoke yield from PMMA tested in the NBS chamber was different from the results of the EU chamber test (higher smoke yield under non-flaming than with flaming conditions). The reason for this may be the condensation of methylmethacrylate vapour inside the small volume NBS chamber. When calculating the concentration of vapour in the chamber before and after the test, it was noticed that over saturation was reached inside the chamber, which would cause condensation and formation of a mist. This would be detected as smoke, 70 gm/m^3 vapour is required for saturated condition inside the chamber (at 45°C), while the concentration expected at the end of the test is 86 gm/m^3. In the EU chamber, about 52 gm/m^3 (at 25°C) were needed to convert the atmosphere to a saturated state compared with only 32 gm/m^3 expected at the end of the test (Weast, 1981/82).

5.1.3 Arapahoe Chamber

The results are shown in Table 4.20 to 4.34. Six replicates were tested for each material. The coefficient of variation, as shown in Table 4.8, varied from 2 to 15% for the smoke calculated on weight loss, and from 1 to 18% for the smoke based on initial weight. The average for the coefficient for all materials was better for smoke calculated on weight loss (9.6%) than for smoke calculated on initial weight (11.2%). This finding is in good agreement with that of Hilado and Machado (1978). The variation in the smoke based on weight loss for 8 out of the 15 materials tested was very small and in the range of 10% to 16% (Table 4.19).

5.1.3.1 Variation of experimental parameters

Certain parameters have been varied and the results summarised in Tables 4.35 to 4.39. The first parameter which was changed was the burning time. Less smoke was collected with a longer burning period. This was probably due to a more efficient burning, as the sample was covered with flame for a longer period of time. This means that in the last stages, under the standard condition the sample may smoulder (non-flaming), while with an increase in the burning time, the sample burnt for longer under a flaming condition but with less smoke.

The second parameter to be changed was the airflow time. The results showed no significant effect for either increasing or decreasing the time of airflow for two materials (white pine and PVC) (Table 4.37).

The burner to the sample distance inside the chamber was varied. Two distances were chosen, 30 and 15 mm (Figure 5.11). The results (Table 4.38) show no significant effect on the smoke production with little effect on the weight loss.

Double thicknesses (6.4 mm) of white pine and PMMA were tested (Table 4.39). For both, the flame was insufficient to burn the sample, so the white pine smouldered and produced more smoke.

In general, the variation of the experimental parameters has little or no significant effect on smoke production in the materials tested. This is an advantage for a standard test.

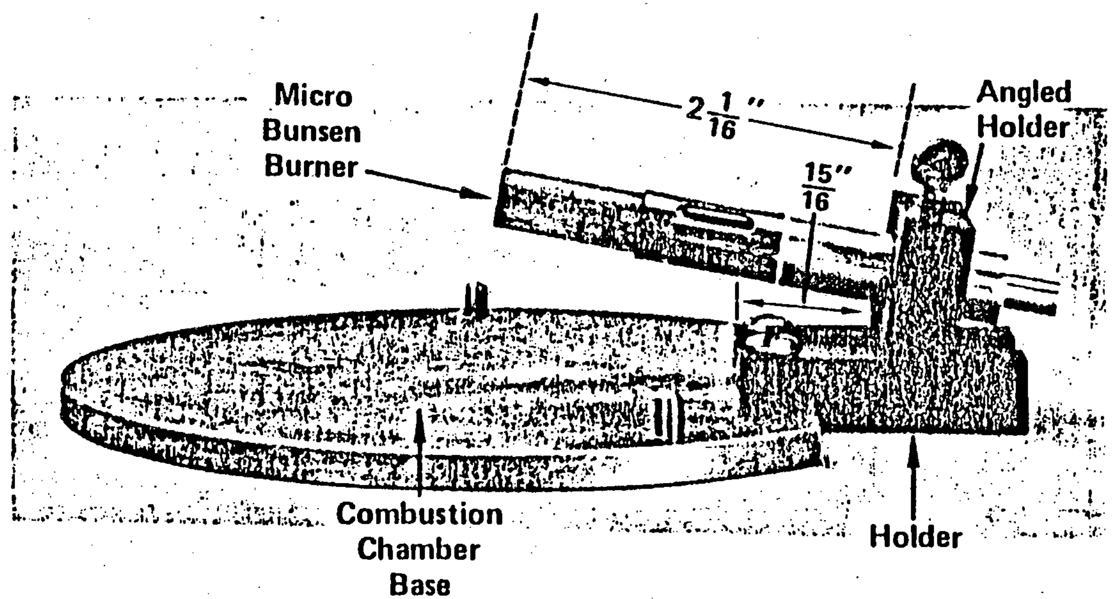

FIGURE 5.11: Propane micro burner positioning.

Conclusion

It is not possible to compare the results from these materials with results from other sources as we cannot say if the compositions are the same.

For the NBS chamber, only standard procedure was carried out and the results will be compared with the EU tests in Section 5.2.1. For the EU test, different parameters varied as follows:

1. *Thickness:* A proportionality was noticed between D_s and the thickness of PMMA and foam, but not for fibreboard, which is in a good agreement with the conclusion of Hilado (1970) and Gaskill (1970).

2. *Combination of two materials:* When two materials were burnt together, the smoke yields were additive.

3. *Heat flux:* Smoke yield increases with increased heat flux.

5.1.4 Fire compartment method

5.1.4.1 General and static measurement

The reproducibility of the data obtained in these experiments was reasonable, considering that even under the strictly controlled condition of the NBS test, it is difficult to improve the precision to better than 25%. With a compartment like this, some oxygen depletion was expected especially for the large cribs under restricted ventilation (10 cm), as the maximum air rate inflow was less than that needed for the maximum rate of burning, the competition between oxidation-pyrolysis in the flame and hot gases becoming dominated by the process of pyrolysis. (The competition depends on the fuel/air ratio, with pyrolysis being dominant under fuel-rich conditions, while under air-rich conditions oxidation is dominant.) Some of the gases may be recirculated inside the box, but the residence time is not known. Under these circumstances, the smoke yield can be expected to be high.

It is important to know whether the burning takes place in fuel or air rich conditions. Therefore, different ways have been used to study burning conditions, namely:

(a) comparing the rate of burning with the rate of air inflow;

(b) comparing the total amount of fuel bed burnt with the total amount of the oxygen entered in the fire compartment;

(c) the method developed by Harmathy (1976):

when $\frac{\rho g^{\frac{1}{2}} A\sqrt{H}}{A_F} > 0.290$, the fire is controlled by the surface area of the fuel (i.e. fuel-controlled);

$\frac{\rho g^{\frac{1}{2}} A\sqrt{H}}{A_F} < 0.235$, the fire is ventilation-controlled.

Where ρ is the density of air (kg/m^3), g is the acceleration due to gravity, A is the area of the opening (ventilation, m^2), H its height (m) and A_F is the exposed surface area of the combustible material (m^2) (wood cribs only).

The total amount of oxygen needed for each fuel bed under stoichiometric conditions is calculated and compared with the total amount of oxygen entering into the box during the period of burning (burning time calculated as in Figure 5.12). The maximum rate of airflow is also calculated and compared with the oxygen required for the maximum rate of burning. Table 5.4 shows the calculated results and Figure 5.13 shows the stoichiometric line between the air-rich and fuel-rich conditions. Small cribs, PP and PMMA (from Figure 5.13) are in an air-

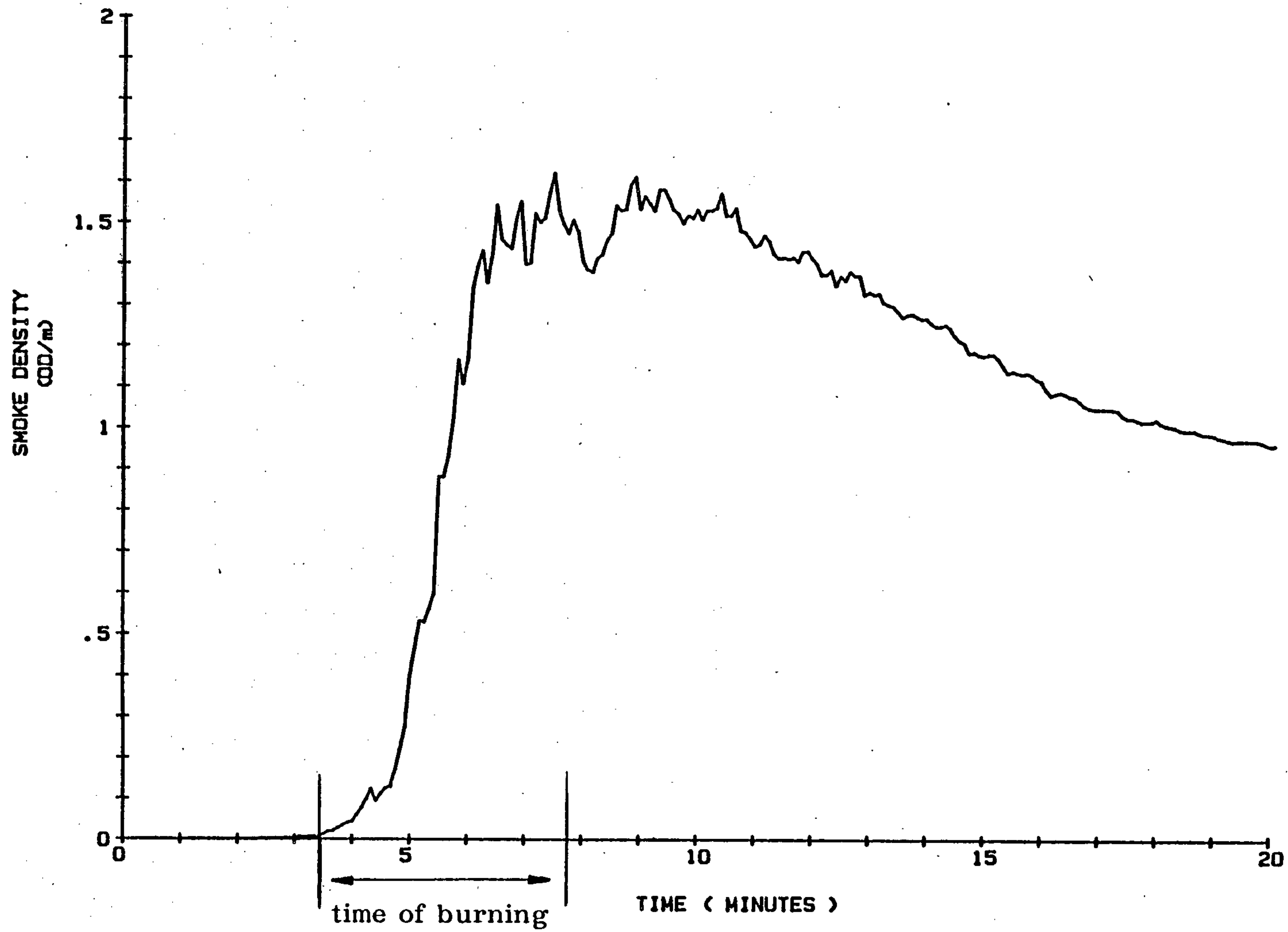

FIGURE 5.12: Time of burning.

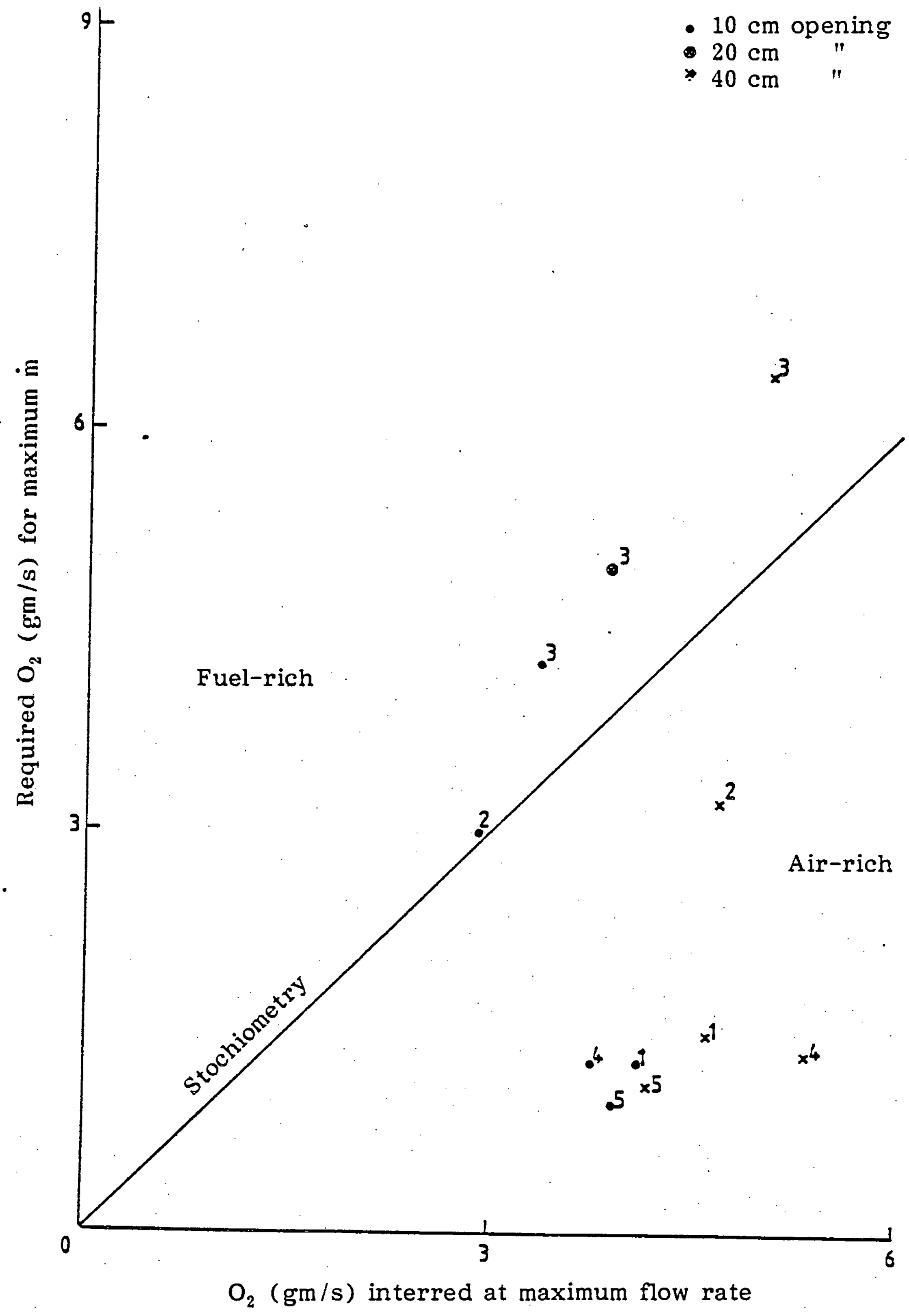

FIGURE 5.13: Oxygen balance.

(1 = small cribs; 2 = medium cribs; 3 = large cribs; 4 = PMMA; 5 = PP)

TABLE 5.4: Oxygen balance.

Fuel bed	O_2						
	Total amount required (gm)	Amount entered during burning time (gm)		Amount required for maximum $\dot{m}$ (gm/s)		Amount entered from maximum rate of airflow (gm/s)	
		10 cm (opening)	40 cm (opening)	10 cm (opening)	40 cm (opening)	10 cm (opening)	40 cm (opening)
Small cribs	440	1050	1300	1.27	1.47	4.08	4.58
Medium cribs	1100	1050	1750	2.97	3.22	2.92	4.67
Large cribs	2100	1300	1700	4.25	6.42	3.33	5.00
PMMA	460	650	950	1.28	1.35	3.75	5.33
PP	275	720	830	0.97	1.10	3.92	4.17

rich condition, large cribs are in fuel-rich condition, while for medium cribs, the 10 cm opening test is in a fuel-rich condition, and 40 cm ventilation test is in an air-rich condition. For PP (and probably PMMA) observation shows the burning to be air-rich for most of the test. However, after "flashover" the burning was clearly fuel-rich when external flaming occurred for the last 20-30 seconds of the fire.

The results of applying Harmathy's (1976) test to the data from these experiments are presented in Table 5.5, for wood. These values show that for small cribs under both ventilation conditions (10 and 40 cm), the combustion is fuel-controlled. For medium cribs, combustion under 10 cm ventilation is ventilation controlled, while under 40 cm it is fuel-controlled. These results agree with the conclusions based on oxygen consumption (Table 5.4). According to the O_2 consumption measurement, all the large crib fires fell in the ventilation-controlled regime. However, Harmathy's test predicts that only the fire with a 10 cm opening was ventilation controlled. The reason for this is not known.

TABLE 5.5: Application of Harmathy's test.

Fuel bed	Value of $\rho\ g^{\frac{1}{2}}\ A \cdot \sqrt{H}/A_F$ for ventilation opening (cm) 10	40
Small cribs	0.324	1.296
Medium cribs	0.185	0.739
Large cribs	0.148	0.594

The effect of ventilation has a variable effect on the smoke production for small and medium cribs. D_O(static) was increased with decreasing ventilation. The large cribs appear to contradict this, particularly because one-quarter and full ventilation give the same D_O(static) when there is no corridor. This can be explained in qualitative terms. The fire plume emerging from the 10 cm opening is seen to be very strong, giving a high turbulent flame in which the efficiency of combustion is likely to increase as a result of greater air entrainment. This will act as an "after burner", and less smoke will be released as a result. With the corridor in place, hot gases flowing along the corridor (which takes about 0.5 to 1.0 second), more pyrolysis can take place under fuel-rich conditions to give more smoke precursors.

The presence of a corridor does not appear to make any significant difference to the value of D_O(static) for small cribs under full and quarter ventilation (Figure 5.14a). These fires were burning under air-rich conditions, and while some flaming was observed outside the ventilation opening of the fire box on its own, flame appeared from the end of the 1 m corridor with a 10 cm opening only occasionally. Combustion of the volatiles would seem to be largely complete within the fire compartment, and there was no further production of smoke precursor from small crib. The burning of the medium cribs appears to be similar (Figure 5.14b). However, the large cribs behaved quite differently, apparently burning within the ventilation controlled (fuel-rich) regime (Figure 5.14c) (when the corridor was present, more smoke was produced). Continued combustion in the gases flowing from the compartment followed by vigorous burning in the fire plume outside the test rig, introduces several other factors which are likely to affect the final smoke yield (see above).

In large scale room corridor experiments, Stark and Field (1974) found that there was no simple relationship between the total amount of smoke (dynamic measurement) and fire load, ventilation and the distribution of fuel. The reason for this, as they recorded, may be due

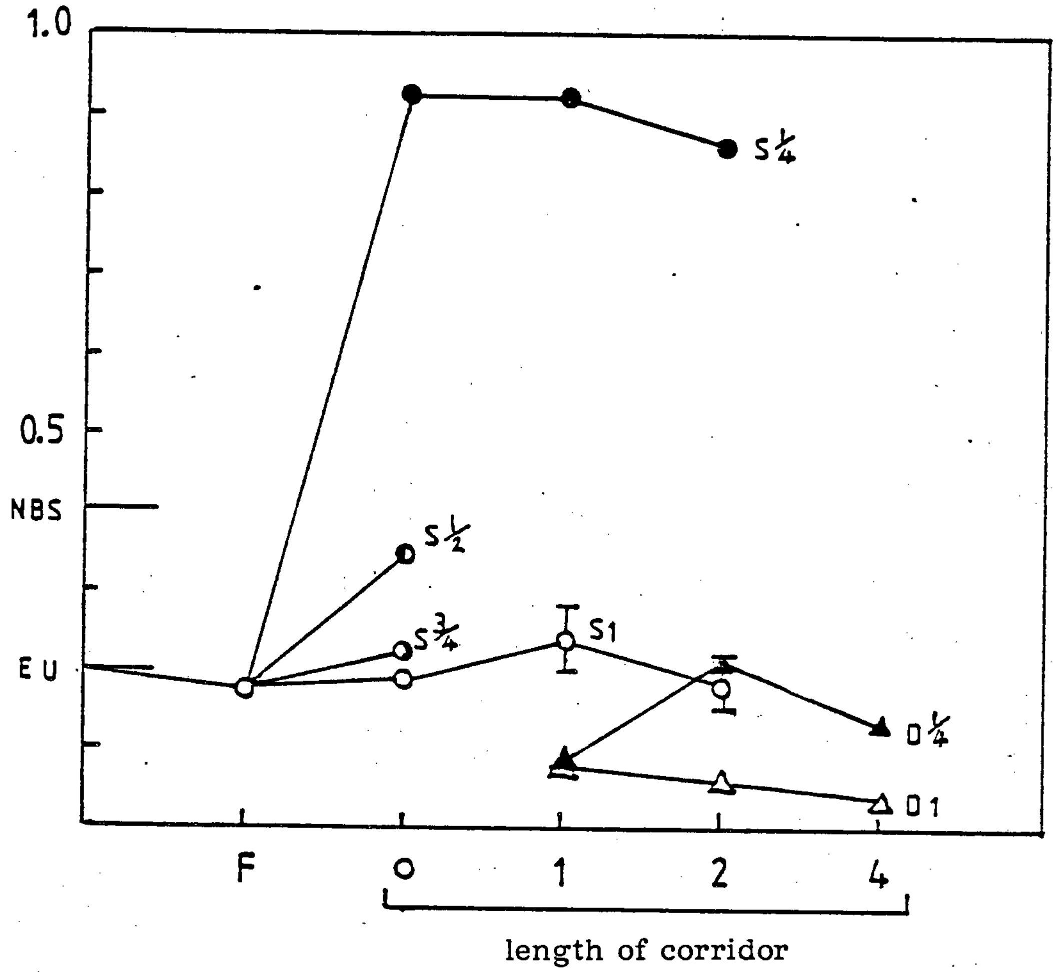

FIGURE 5.14a: Variation of smoke potentials with different burning conditions for small cribs.

D = dynamic
S = static

1, ¼, ½, ¾ = ventilation opening (Fig. 3.15)

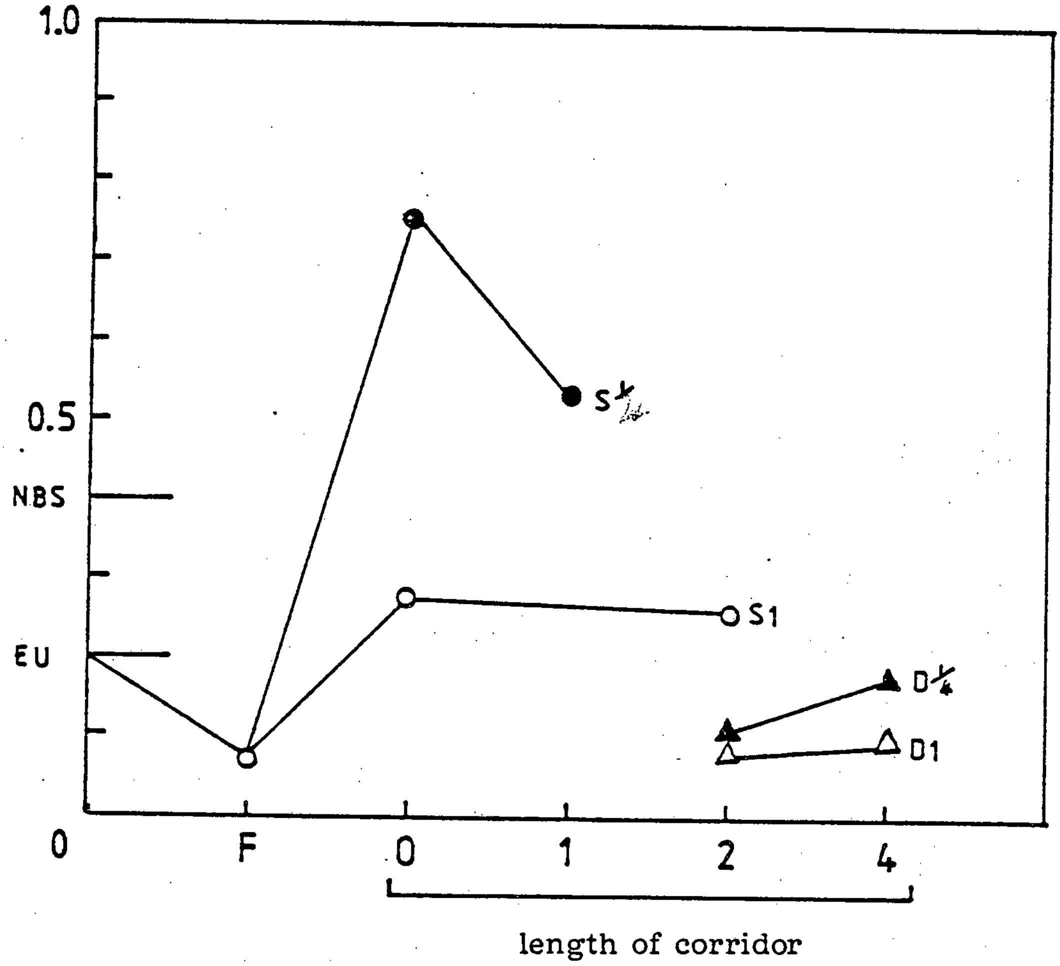

FIGURE 5.14b: Variation of smoke potential with different burning conditions for medium cribs.

D = dynamic
S = static
1, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ = ventilation opening (Fig. 3.15)

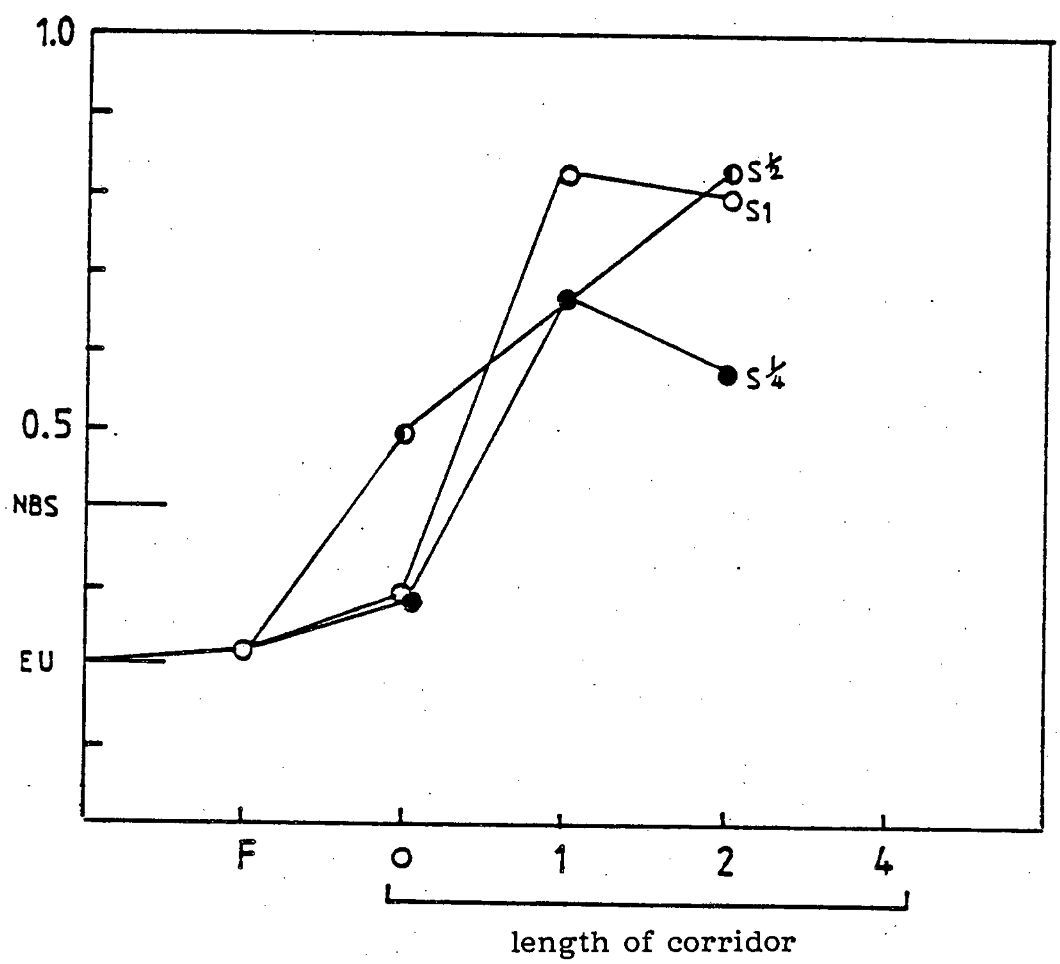

FIGURE 5.14c: Variation of smoke yield with different burning conditions for large crib.

D = dynamic
S = static
1, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ = ventilation opening (Fig. 3.15)

to the variation of the moisture content of the wood and the turbulence of combustion products inside the fire compartment, "because circulation of smoke through the flame zone could result in its partial or complete consumption" (there is no evidence of this happening in this project). Stark and Field seem to have neglected the competition between oxidation and pyrolysis. Figure 5.15, from the same work by Stark and Field (1974), shows the effect of moisture content on the temperature of fire gases for moisture content of <12% and >13%. This figure shows that with a moisture content of under 12%, the effect on temperature is very small. The moisture content of wood cribs tested in this project was well under 12% (7% to 11%), and is assumed to have little effect on the smoke yield. They also found that as the ventilation decreased, the total amount of smoke produced as measured dynamically increased. This is in agreement with present results for small and medium cribs and PMMA, but not for PP (Figure 5.16) (dynamic measurement).

The comparative behaviour of PMMA and PP merits comment. Under free burning conditions D_o(static) for PP is almost ten times greater than D_o(EU). This may be a consequence of the difficulties associated with testing a material which melts and flows so readily in the vertical orientation (PMMA softens but does not flow significantly), but equally it may reflect a difference between horizontal and vertical burning. Breden and Meisters (1976) found that D_s maximum is much greater for a thermoplastic material in the horizontal configuration than in the vertical orientation in the smoke density chamber (Section 2.3.1.1c). D_o(static) for PMMA increases by factor of three when it is burnt within the fire box with one-quarter ventilation, while the increase is only 15% for PP (Table 4.26). One of the factors which may account for this is the difference in these emissivities (that of PMMA is much lower than that

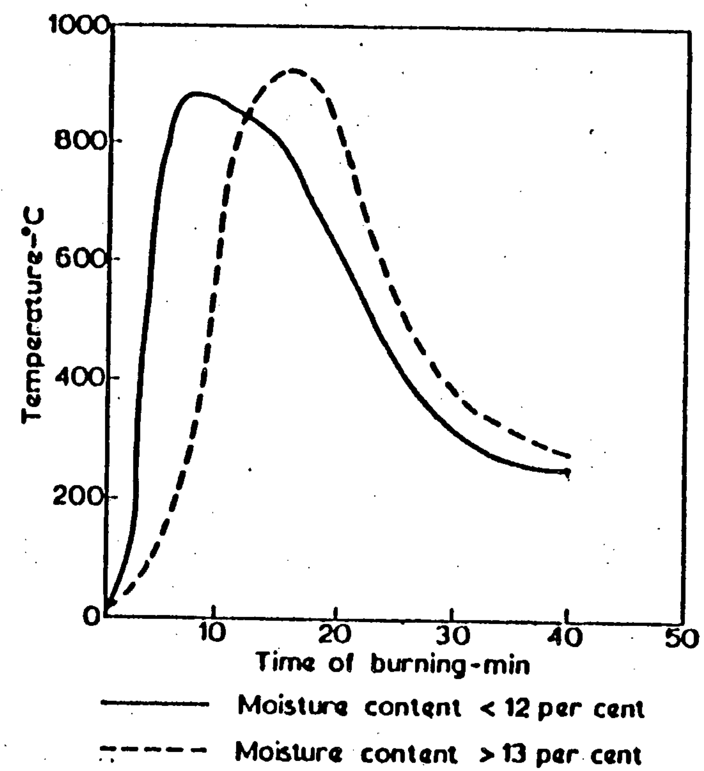

FIGURE 5.15: Effect of moisture content (Stark *et al.*, 1974).

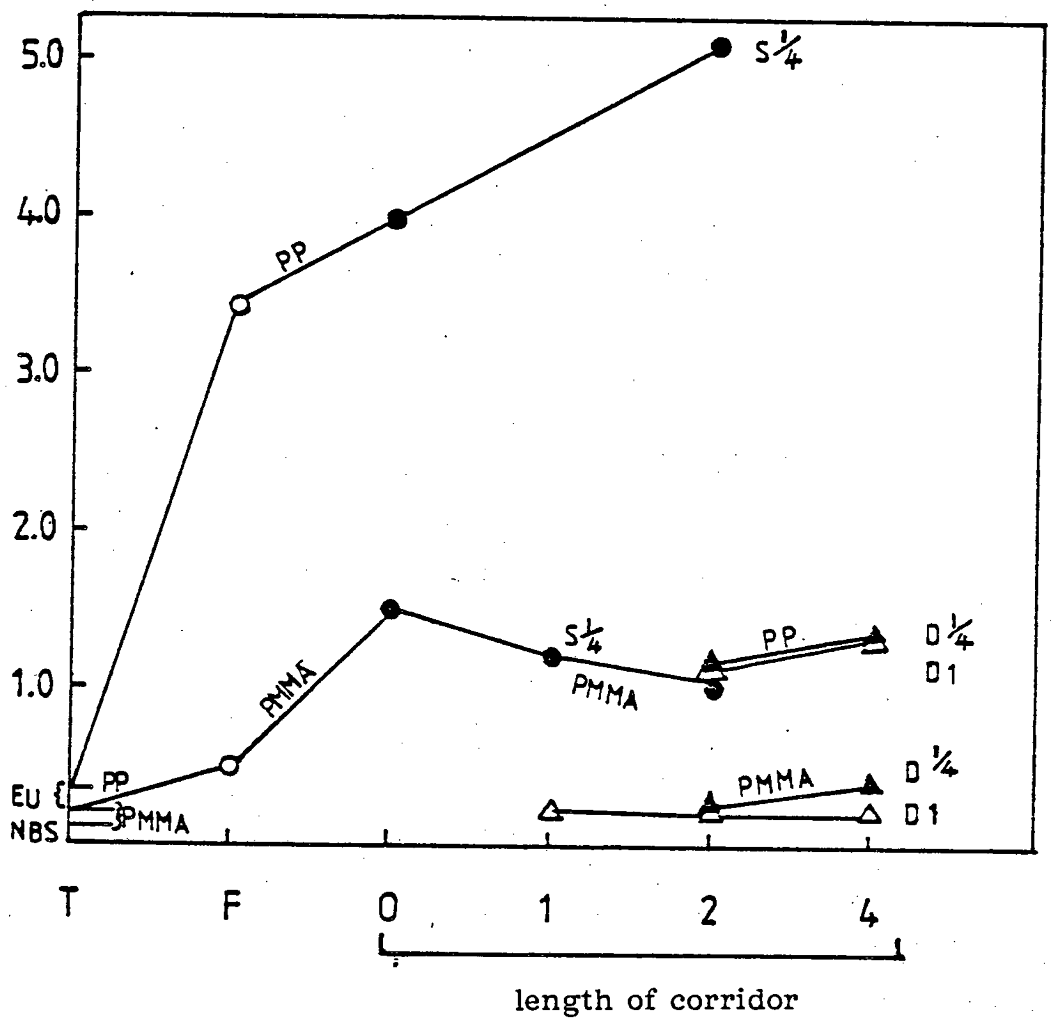

FIGURE 5.16: Variation of smoke potential with different burning conditions for plastics.

D = dynamic
S = static
1, ¼, ½, ¾ = ventilation opening (Fig. 3.15)

of PP). Because emissivity of flames above burning PMMA is low, the burning rate of PMMA is more sensitive to the radiative heat feedback within the box. Markstein (1978) studied the radiative output of flames above 31 cm diameter slabs of different materials. His results for PMMA and PP are shown in Figure 5.17 which demonstrates not only that the emissivity of PMMA flames is lower than that of PP (e.g. at 10 cm height above fuel, it is 0.2 and 0.4 for PMMA and PP, respectively), but also as the height above the fuel increased, the decrease in emissivity was more pronounced for PMMA than for PP. Markstein also found that the rate of burning of PMMA (10 gm/m^2.s) using a fuel bed of 31 cm in diameter, is higher than that of PP (8.4 gm/m^2.s), in spite of the fact that the emissivity of PP is higher than that of PMMA, but this can be explained in terms of the differences in the heat required to produce the volatiles: that of PP is 25% larger than that of PMMA (Tewarson and Pion, 1976). The same trend was found in the results of this project, although the $\dot{m}$ for PMMA was more than double the $\dot{m}$ for PP (7.5 and 3.1 gm/m^2.s, respectively in a free burning condition). This may be due to the differences in size of fuel beds in heat loss conditions and in the exact chemical composition of the material used.

The yield of smoke from the wood cribs burning in the fully ventilated fire box was not significantly different from that of free burning. This is consistent with the fact that the greater proportion of the burning surface of wood cribs is shielded from the radiative feedback from the compartment as a result of the crib structure. This effect may also be responsible for the time to maximum smoke production (t_m) (Table 4.26). For the wood cribs there was no significant difference between burning inside and outside the box, while for PP and PMMA there was a clear difference, 14.5 min for free burning for both

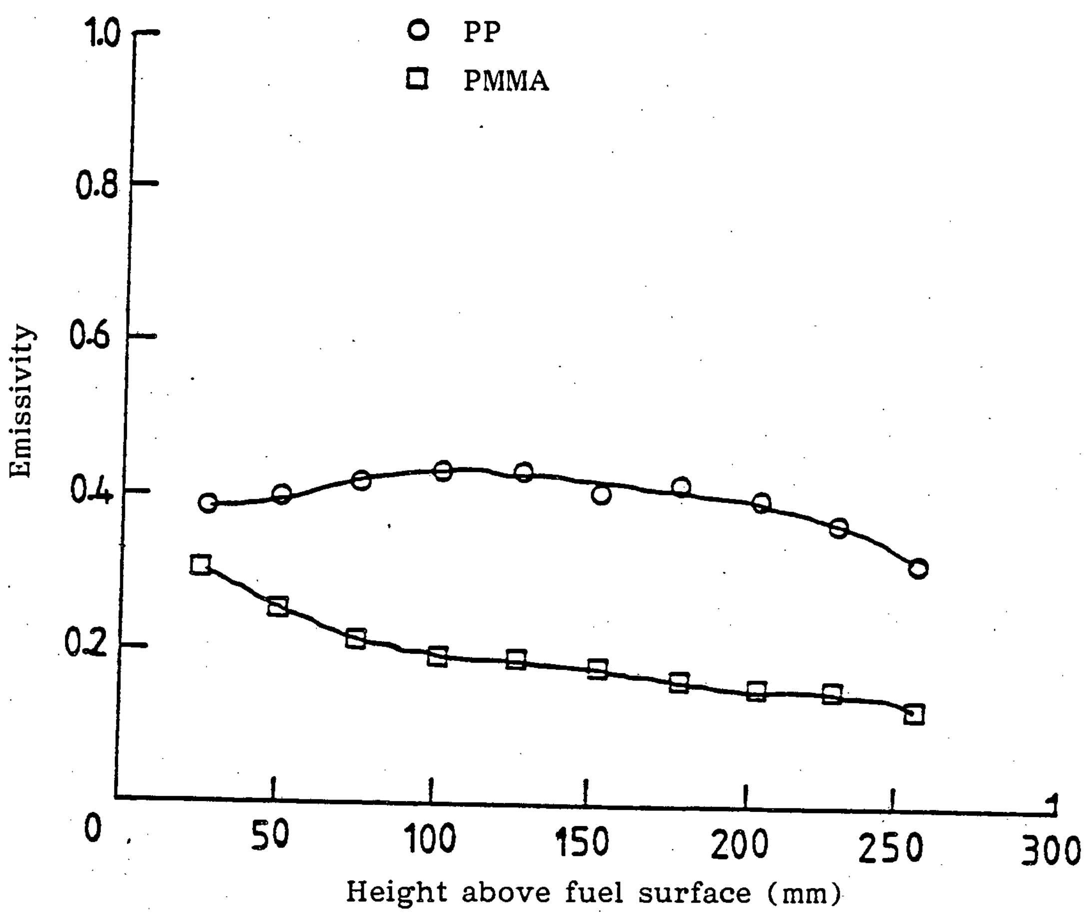

FIGURE 5.17: Emissivity of 0.31 x 0.31 m pool fires for PMMA and PP (Markstein, 1978).

materials compared with an average of 5.5 min inside the box for PMMA and 7 min for. PP.

Table 4.26 shows the rate of burning of wood cribs. For small cribs the weight loss was not recorded because the load cell was not sensitive enough for the small amount of residue which was left at the end of the test, the rate of burning for small cribs is calculated by assuming 20% of the sample remained as char, for each case the $\dot{m}$ = 0.8 x crib weight/burning time (which is calculated from the smoke/time curve, Figure 5.12). The large crib results distributed randomly with a clear trend towards decreasing the rate of burning as the ventilation decreased (Figure 5.18). When $\dot{m}$ was calculated in the same way as for the small crib (based on burning time), the values show a lower $\dot{m}$, but with the same trend (200, 250 and 286 gm/min for 10, 20 and 40 cm openings, box only). The medium cribs showed no significant difference in $\dot{m}$ as a result of different ventilations (except for the 2 m corridor). Using the Kawagoe empirical relationship of 1958 between $\dot{m}$ and ventilation in equation 5.1, where

$$\dot{m} = 5.5\, A\sqrt{H}\ \mathrm{Kg/min} \quad \text{or} \quad 91.7\, A\sqrt{H}\ \mathrm{gm/s} \qquad \ldots (5.1)$$

where A is the area of the ventilation opening (m^2) and H its height (m). The height was constant. In this equation $\dot{m}$ is dependent only on the width of the opening. When the results for $\dot{m}$ for the ventilation-controlled crib fires are compared with values of $\dot{m}$ calculated from equation 5.1 (Table 5.6), the agreement is found to be poor. The reason for this is not clear although it may be due to the relative size of the fuel bed compared with the size of the "fire compartment". However, as expected, the measured rate of burning of the large cribs increased with size of the ventilation opening.

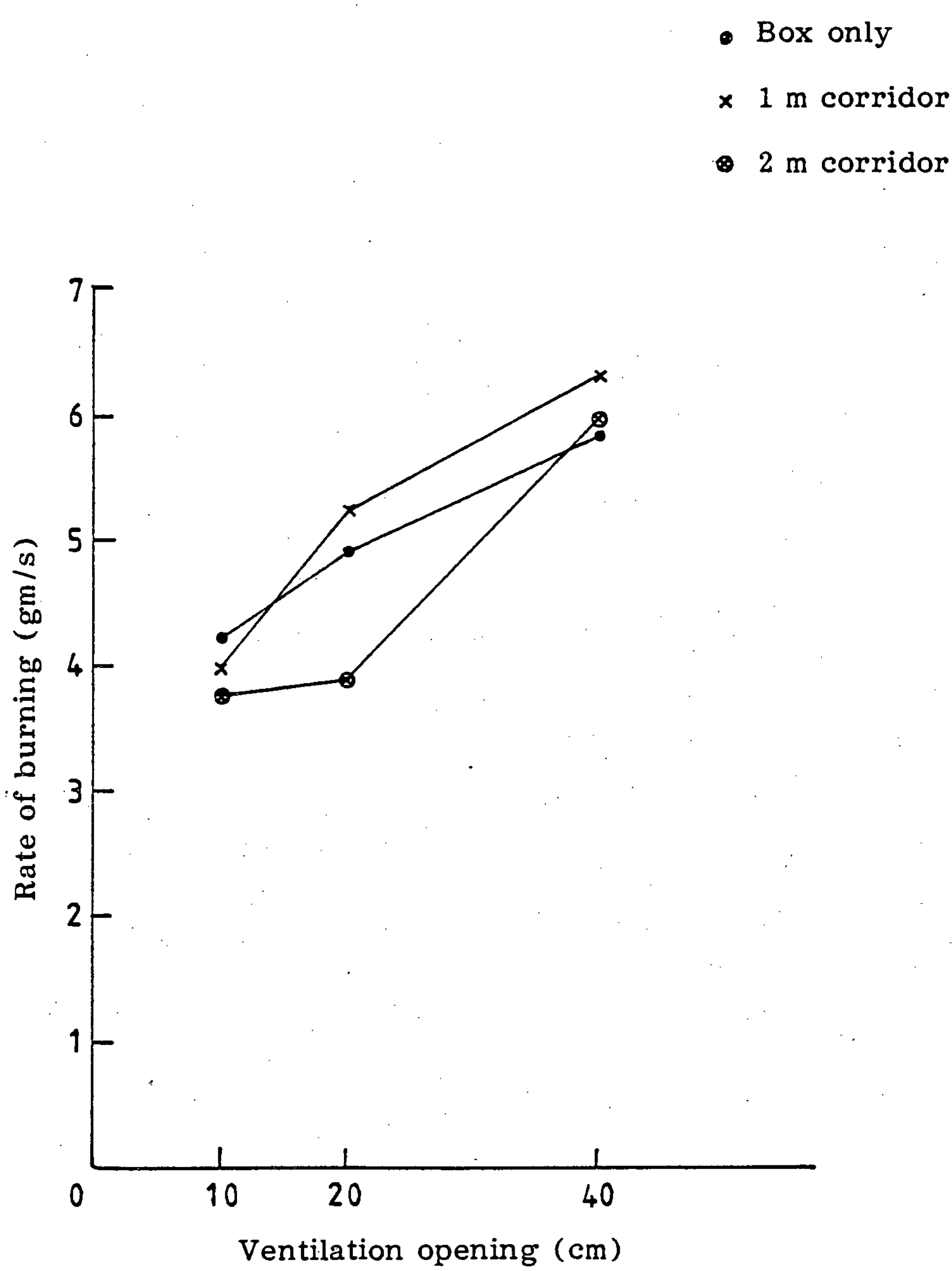

FIGURE 5.18: Variation of rate of burning with ventilation for large cribs.

TABLE 5.6: Comparison of the rate of burning for ventilation-controlled fire, large cribs and medium cribs.

Opening (cm)	Crib size	Measured $\dot{m}$ (gm/s)	Calculated $\dot{m}$ (gm/s)
10	Medium	3.20	2.33
10	Large	3.98	2.33
20	Large	4.67	4.50
40	Large	6.03	9.00

Krause and Gann (1980) used oxygen consumption to measure the rate of heat release. This calculation has been used here, and the heat release converted to the rate of burning in (gm/s). The following equations are used to calculate the rate of heat release (Q_L):

$$Q_L = (0.21 - m_{O_2}).V.10^3.\rho_{O_2}.\Delta H_{c,ox}^{\dagger} \quad \ldots (5.2a)$$

$$\dot{m} = Q_L \div \text{heat of combustion} \quad \ldots (5.2b)$$

Where, V is the volumetric flow of air (m^3/s), ρ_{O_2} is the density of oxygen (kg/m^3) at normal temperature and pressure, and m_{O_2} is the mole fraction of oxygen in the corridor from the compartment, $\Delta H_{c,ox}$ is the heat of combustion expressed in terms of O_2 consumption (oxygen results will be discussed on page 203). $\Delta H_{c,ox}$ is taken as 13.59, 12.98 and 12.66 for wood, PMMA and PP, respectively (Krause and Gann, 1980). The calculated values for $\dot{m}$ by equation 5.2 are presented in Table 5.7 and plotted vs measured $\dot{m}$ (based on weight loss) in Figure 5.19, which shows a good agreement for PP, PMMA and small cribs, but only a reasonable agreement for medium cribs (note, data on oxygen concentration were not obtained for large crib).

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† KJ/g/$\cancel{g}$ O_2

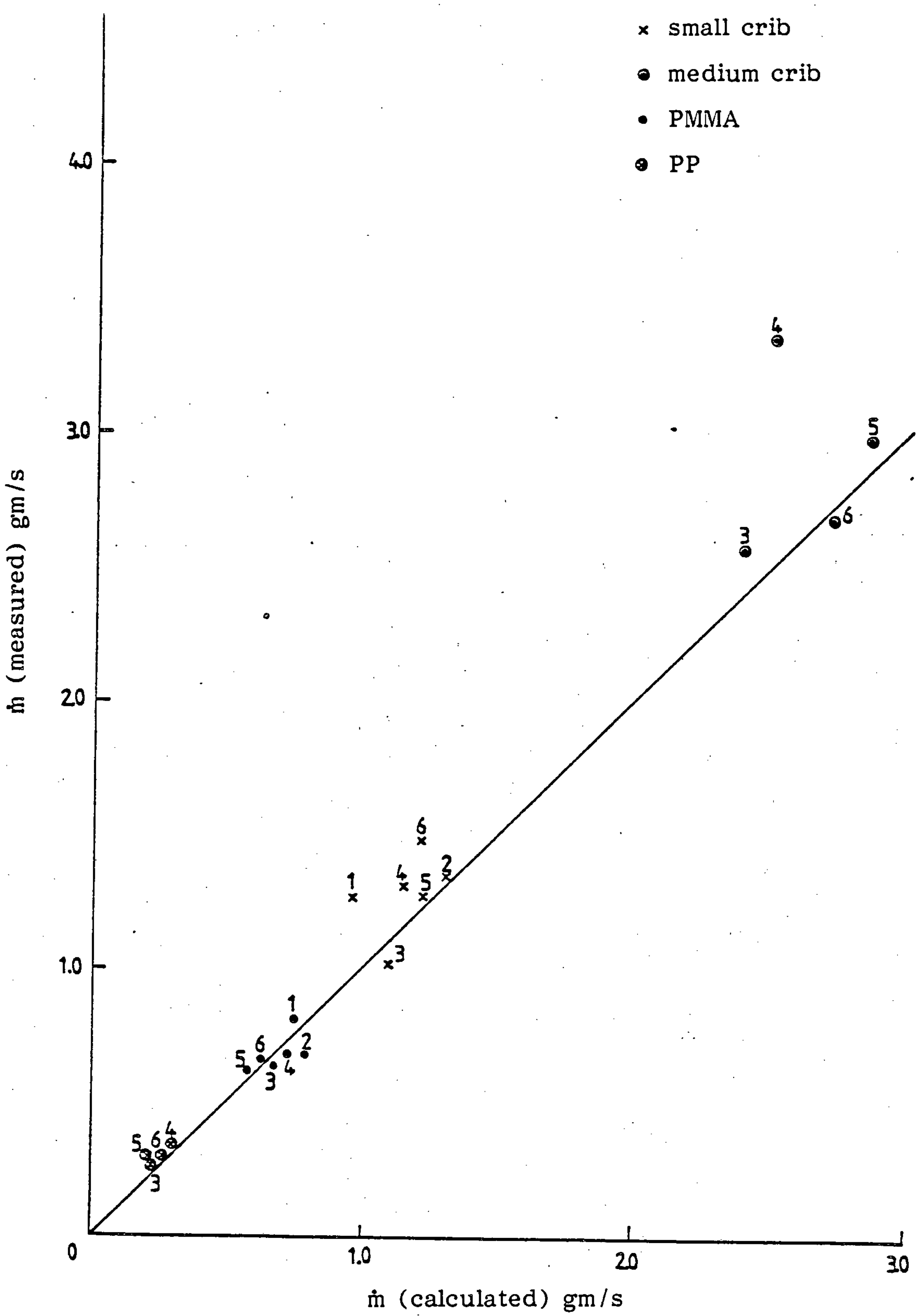


FIGURE 5.19: Rate of burning.

TABLE 5.7: Rate of burning - comparison.

Fuel bed	Corridor length (m)	Ventilation	Measured $\dot{m}$ (gm/s)	Calculated $\dot{m}$ (gm/s)
Small cribs*	1	1/4	1.27	0.97
		1	1.34	1.29
	2	1/4	1.02	1.09
		1	1.31	1.14
	4	1/4	1.26	1.22
		1	1.48	1.21
Medium cribs	2	1/4	2.56	2.40
		1	3.35	2.50
	4	1/4	2.97	2.85
		1	2.68	2.71
PMMA*	1	1/4	0.80	0.75
		1	0.67	0.80
	2	1/4	0.61	0.67
		1	0.76	0.74
	4	1/4	0.61	0.59
		1	0.66	0.64
PP*	2	1/4	0.28	0.25
		1	0.34	0.31
	4	1/4	0.29	0.23
		1	0.30	0.27

*$\dot{m}$ measured, based on weight loss and time of burning.

5.1.4.2 Dynamic measurement

The data from the small and medium cribs show most clearly that D_o(static) is considerably higher than D_o(dynamic) (3 to 10 times higher). A possible explanation for this is that the smoke flowing from the end of the corridor is hot and has not fully matured. A condensation and coagulation process will occur as the hot combustion products cool as they mix with ambient air, yielding a higher concentration of suspended matter, liquid and solid. Seader and Chien (1974) reported the effect of the size of the particle on light scattering and absorption, and consequently on the optical density. They went as far as recommending the use of particulate optical density as a measurement for smoke. Seader and Chien (1974) recorded an equation from Gross *et al.* (1966) for the calculation of specific optical density based on scattering, as follows:

$$D_S = \frac{3X_S(\rho_S/\rho_P)t\Gamma}{9.212r} \qquad \ldots \; (5.3)$$

Where X_S is the efficiency factor for light scattering which will depend on r; ρ_S and ρ_P are the density of sample and particulate density, respectively; t is the thickness of the sample; Γ is the fraction of sample that becomes particulate matter; and r is the particulate radius. From equation 5.3, they plotted $D_S(\rho_P/\rho_S)/t\Gamma$ vs. diameter (Figure 5.20) to show the effect of particle diameter on the D_S. They concluded that there were three regions: when the droplet diameter is less than 0.15 micron, D_S is proportional to the cube of the droplet diameter. When the droplet diameter is more than 10 microns, the D_S is inversely proportional to the droplet diameter. In the region of 0.3 to 0.7 micron, the D_S seems independent of droplet diameter. As far as the absorption is concerned, as the particles' diameter became approximately equal to or larger than the wavelength of light, the particles will absorb and reflect as well as scatter. Further condensation of the particles may lead to a higher optical density for cold smoke (static). Another possibility for higher D_O static than dynamic measurements, is the water which is still present in the vapour phase at the temperature measured in the outflow and which may condense as the plume cools when it mixes with air. However, it can be demonstrated that condensation will not occur. The total amount of water produced during the test is not sufficient to produce a saturated atmosphere. Small cribs, PMMA and PP fires gave a concentration of water of 1.0,

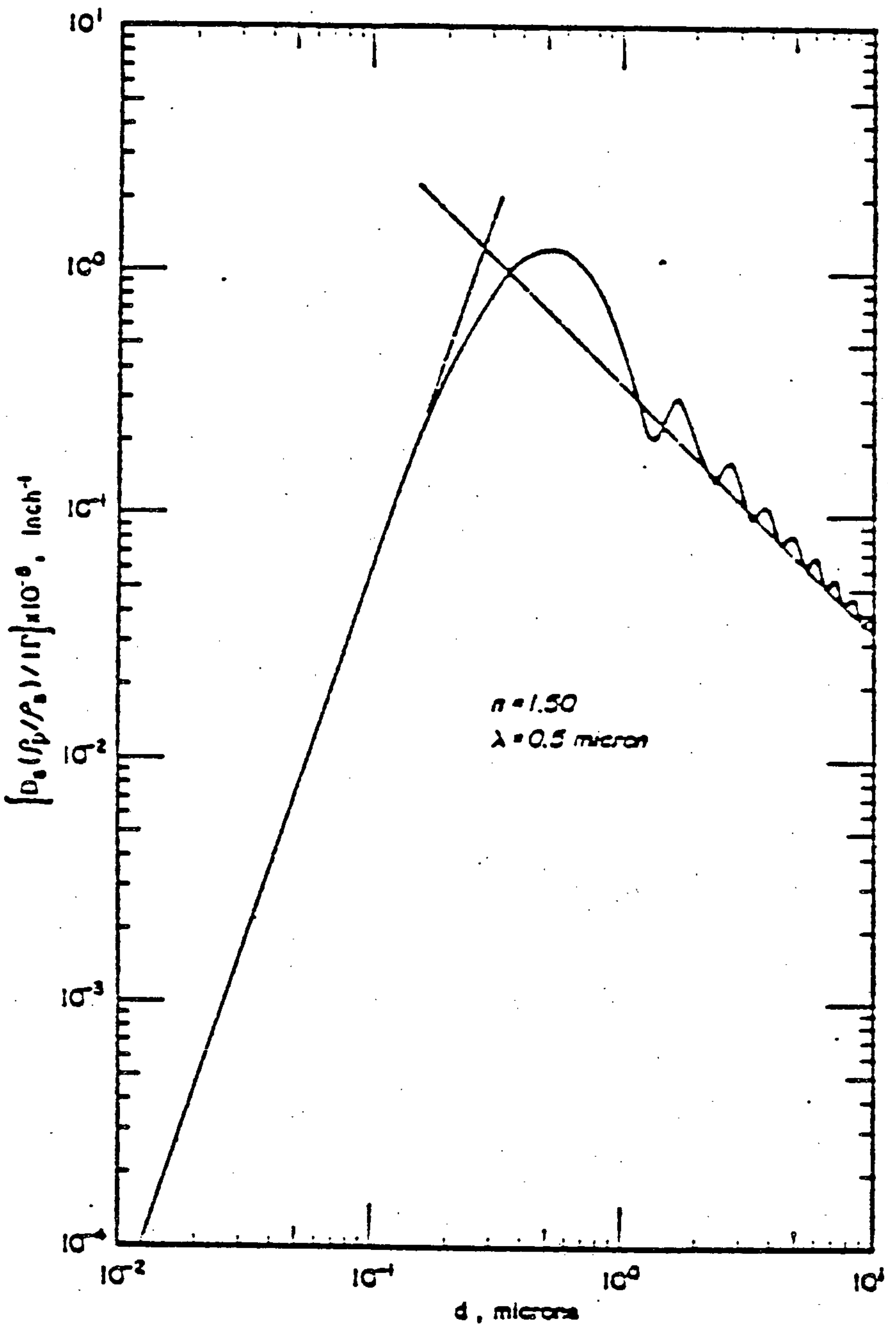


FIGURE 5.20: Effect of particle diameter on D_S.

0.7, 0.5 gm/m^3, respectively. Even at ambient temperature, the saturated vapour has a concentration of 16 gm/m^3. With a relative humidity of 100%, this vapour can produce a mist, but the relative humidity is normally in the range of 80 to 85%. It is probable that all the vapour was collected in the space under the ceiling (50 cm depth) of the test room, where the temperature was 40-50°C. Under these conditions a saturated atmosphere was not reached, as the high temperature (40-50°C) leads to a higher saturated vapour pressure.

To test the above hypothesis about cooling the smoke, a 2 m extension was used to investigate whether an additional cooling would result in a higher D_O(dynamic). The temperature was still above 200°C. As can be seen in Figure 5.14a,b the results are inconclusive. If smoke temperature is the main factor in creating this discrepancy, it would seem that greater cooling is necessary to produce a significant effect. In addition, there are some technical and practical points which may lead to errors in the value of D_O. These relate to the validity of the method of measurement which assumes a uniform flow from the corridor, which is not the case, and are as follows:

(a) The temperature: The observed temperature of the outflowing gases exhibited fluctuation of ±20K maximum, which will affect the instantaneous value of V_f and thus D_O(dynamic). This variation gave ±3%.

(b) The width and the depth of the smoke layer were assumed uniform for the calculation.

• *The width*

Two Supalux sheets were used at the end of the corridor from outside (Section 3.2.1, Figure 3.16) to confine the smoke when leaving the corridor. This means that the width of the smoke plume was effectively diluted as the width increased from 40 cm to 50 cm. This may result in a 20% reduction in the readings.

• *The depth*

Cling film was used to cover the lower third of the corridor's upper part opening (Section 3.2.1). The depth of the smoke layer was measured from the corridor ceiling to the upper edge of the cling film, which shrank if the layer of hot, flowing gas was too deep. At the early and late stages of the fire the smoke layer did not fill the whole of the opening (between cling film and the upper part of the corridor). It is very difficult to estimate the error here, as there was a difference between the wood fires and plastic fires, and even a difference in how this area was filled by the smoke outflow from the corridor because of the different size of fuel bed. However, as the smoke concentration was low at the early and late stages, its effect on the results is likely to be small. Assuming that 90% of the smoke flowed out of the corridor completely filling the whole opening between the ceiling and the cling film, 10% would have flowed through this opening in the early and last stages of the fire with a lower depth. If it is assumed that this 10% flowed out through the upper half of the opening, then the volumetric flow rate during these periods will be under-estimated by 50%. However, this will lead to an under-estimate of D_o by only 5%.

The two parameters (width and depth) showed that the assumption of uniformity is not strictly applicable, but at the same time there was no simple way to measure these during the fire. In addition to this, the smoke was treated as a homogenous layer, with no temperature profile, although stratification can be expected. The thermocouple was $\sim$5 cm beneath the ceiling.

Another source of error in this connection is the change in the optical depth as a result of the entrainment of air into the plume leaving the corridor and before being detected by light source. Without measuring this effect on smoke results, there is no possibility of estimating its effect on D_o .

(c) For small cribs, the weight loss was assumed to be 80% for all the tests as the sensitivity of load cell was not enough to detect the difference in weight. To check this, a small crib burnt freely inside the chamber (EU chamber) using an electrical balance to check the weight loss. At the end of the test ~15% of the initial weight was left as a residue and 85% burnt. This means a 7% difference from the calculated D_o(dynamic). (The figure 80% instead of 85% is used because 80% was the average for all the medium and large cribs while 85% was only seen in free burning test.) For all the three types of crib, the char will be oxidizing during flaming combustion which will lead to under-estimating the char. This cannot be quantified.

As the factors above have their effect on both sides (some increasing and others decreasing D_o), so the following equation is used to calculate the total percentage of error (The Open University, 1971):

$$\frac{\Delta Z}{Z} = \left\{ \left(\frac{\Delta A}{A}\right)^2 + \left(\frac{\Delta B}{B}\right)^2 + \left(\frac{\Delta C}{C}\right)^2 + \text{------} \right\}^{\frac{1}{2}} \quad . \quad . \quad . \; (5.4)$$

Where Z is the quantity to be evaluated from the quantities of A, B, and C, ΔA, ΔB and ΔC are the errors in the quantities A, B and C etc. Equation 5.4 gives an error of 22%. This error represents only a small part of the difference between the D_o(dynamic) and D_o(static) which means that the other factors which have already been discussed are likely to account for the difference.

Generally speaking, the reproducibility of this system was good in spite of the different parameters which can affect the results, e.g. the ambient temperature, the relative humidity, presence and absence of the wind, its direction and so on.

The present results that D_O(dynamic) < D_O(static) are contrary to the report by Paul (1983) which indicated that for an upholstered polyether foam cushion, D_O(dynamic) is greater than D_O(static) by as much as a factor of "3". While the reason for this apparent discrepancy has not been resolved, it is worth noting some differences in the experiments, in addition to the material involved. The volume of the chamber used by Paul was 100 m^3, in which substantially greater quantities of smoke were being collected than in the present tests with a volume of 240 m^3. Secondly, Paul waited for 15-20 minutes after the fire had ceased before making his static measurement. An ageing process will certainly be operating and may be significantly more rapid at higher concentration. However, this may not account for more than 25-30 per cent of D_O(static) over this period (15-20 minutes). Two other differences should be mentioned. In Paul's experiments, the combustion gases were discharged vertically from the rig through a duct, which would have resulted in their direct impingement on the ceiling, approximately 1 m above the outlet. In this present test, the discharge was horizontal and the distance to the ceiling was approximately 2 m. Loss of smoke particles by deposition on the ceiling could have been significant in Paul's experiments which were carried out in a closed room corridor assembly with a much higher surface to volume ratio than the fire house at Gullane.

5.1.4.3 Production of fire gases

Oxygen, carbon monoxide and carbon dioxide concentrations were measured continuously in the outflowing gases (Figure 3.17), either at the end of the corridor, or in the fire box if no corridor was present. Table 4.26 shows the results of the gases produced during the test, and these results were discussed in Section 4.2.4. Generally speaking, the gas concentration is ventilation dependent. By increasing the length of the corridor and for the same ventilation and fuel bed, the CO_2 and CO concentrations were decreased which may be due to the leakage between the box and the corridor, and (or) between the two corridors.

Total CO_2 produced during each test has been calculated from the concentration/time curves through the tests. This was compared with the expected amount of CO_2 by assuming that all the carbon in the sample is converted to CO_2 when it is burnt. The results show that the measured total amount was less (~25%) than predicted. This may be due to the amount of C which converted to smoke, CO and other carboneous component, or may be to the uncertainty of char left.

From a paper by Shore *et al.* (1952), an optical density of 1bel/m corresponds to a smoke concentration of 0.33 gm/m^3. Assuming that this is independent of the source of the smoke (Rasbash, 1967), this figure is used to estimate the amount of carbon converted to smoke during the combustion. Table 5.8 shows the total weight of carbon expected from each sample and the amount of carbon in the CO, CO_2 and smoke. The results show a difference between the two (measured and predicted) for wood, as the measured total amount of carbon is between 5% and 18%, which seems a very large difference to be accounted for entirely by the formation of other carbon containing products. The

TABLE 5.8: Carbon balance.

Fuel bed	Ventilation (cm)	Corridor (m)	C(gm) Expected	CO_2	CO	Smoke	Total calculated	% Weight loss	D_o (ob.m^3/gm)
Small cribs	10	1	168	146	10	12.2	168	80	0.09
	40	1	170	132	9	3.4	144	68	0.08
	10	2	165	134	7	12.0	153	75	0.22
	40	2	162	126	8	2.4	136	67	0.07
Medium cribs	10	2	401	343	29	17.7	390	78	0.11
	40	2	396	328	21	8.7	358	72	0.20
PMMA	10	2	141	113	13	8.8	135	96	1.13
PP	10	2	73	51	6	13.0	70	96	4.78

results for PP and PMMA were in better agreement (3% to 5%). The large difference for wood cribs needs to be considered. The total amount of carbon in the volatiles is calculated assuming that only CO, CO_2 and "smoke" are produced, and used to estimate the amount of residual char which was assumed to be carbon. These results are tabulated in Table 5.8, with D_O based on weight loss calculated from the latter figure showing a small difference from actual D_O. When the weight loss is calculated as a percentage of the initial weight, the percentage is in the range of 67 to 80 for small cribs and 74 to 77 for medium cribs (Table 5.8).

It is clear from Table 5.8 that most of the carbon is converted to CO_2 (about 75% to 90%), while CO, although it is produced in a smaller amount, is a significant toxic product.

Stark and Field (1974) introduced the parameter "fireload" $A\sqrt{H}/W$, where A is the area of the ventilation (m^2), H its height (m) and W is the weight of the fuel (kg). They found that the concentration of CO (maximum percentage concentration in the outflowing gases) was favoured by a higher fire load, a higher temperature in the fire compartment and a lower degree of ventilation (240 and 700 mm width opening). Rasbash (1967) mentions a relation between the CO maximum concentration and the parameter $A\sqrt{H}/W$. Stark and Field (1974) plotted the same two parameters, but they reported that the relation found by Rasbash did not exist for their work.

The two parameters (CO and $A\sqrt{H}/W$) are plotted in Figure 5.21. From the values of this project, the figure shows that no relation exists between the CO and the fire load parameter. The total amount of CO produced per gram of fuel bed (l/gm) is plotted Vs the D_O(static) in Figure 5.22, which shows a trend for CO to increase with the increase of D_O for small and medium cribs.

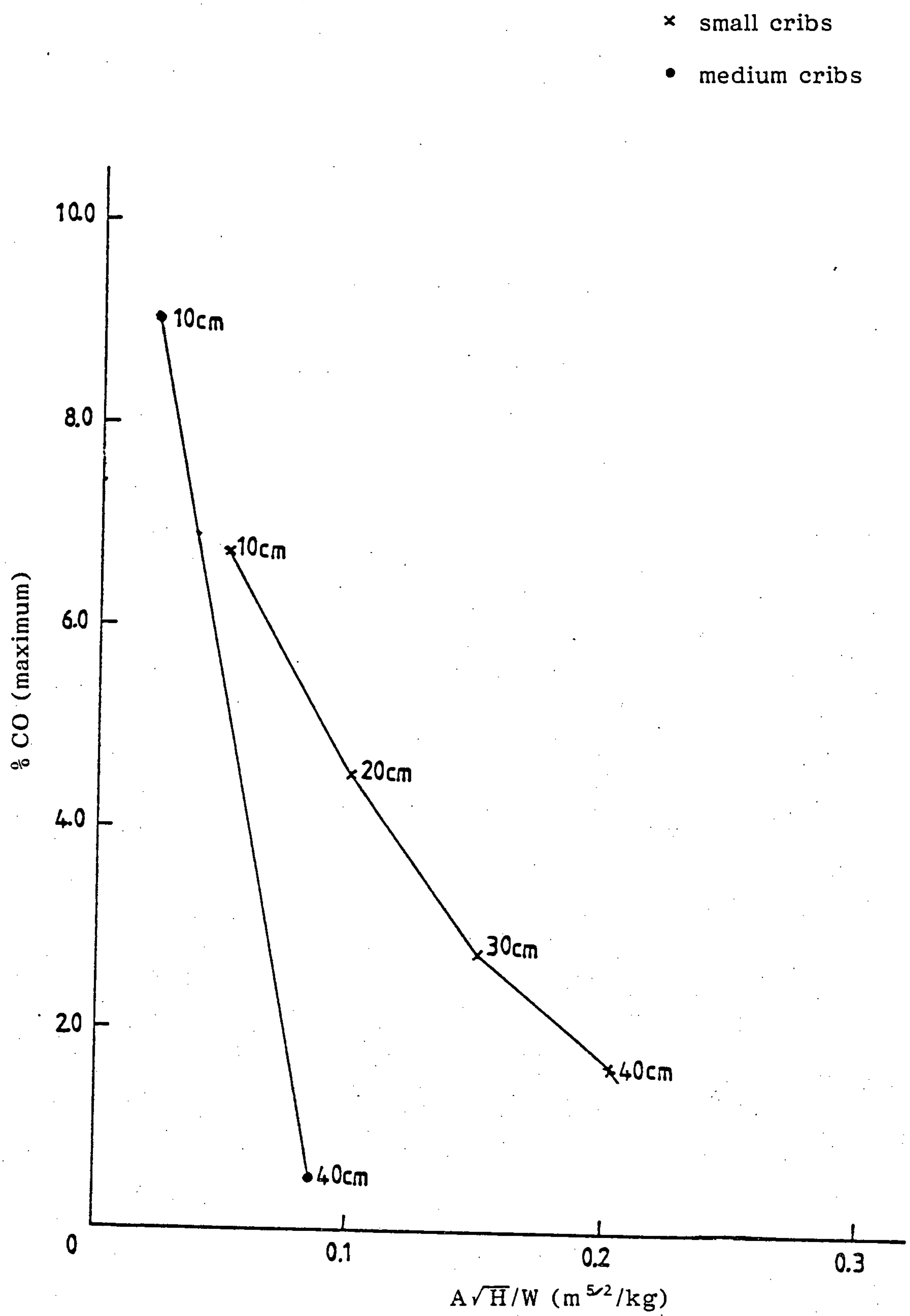


FIGURE 5.21: Comparison of % CO with fireload term ($A\sqrt{H}/W$).

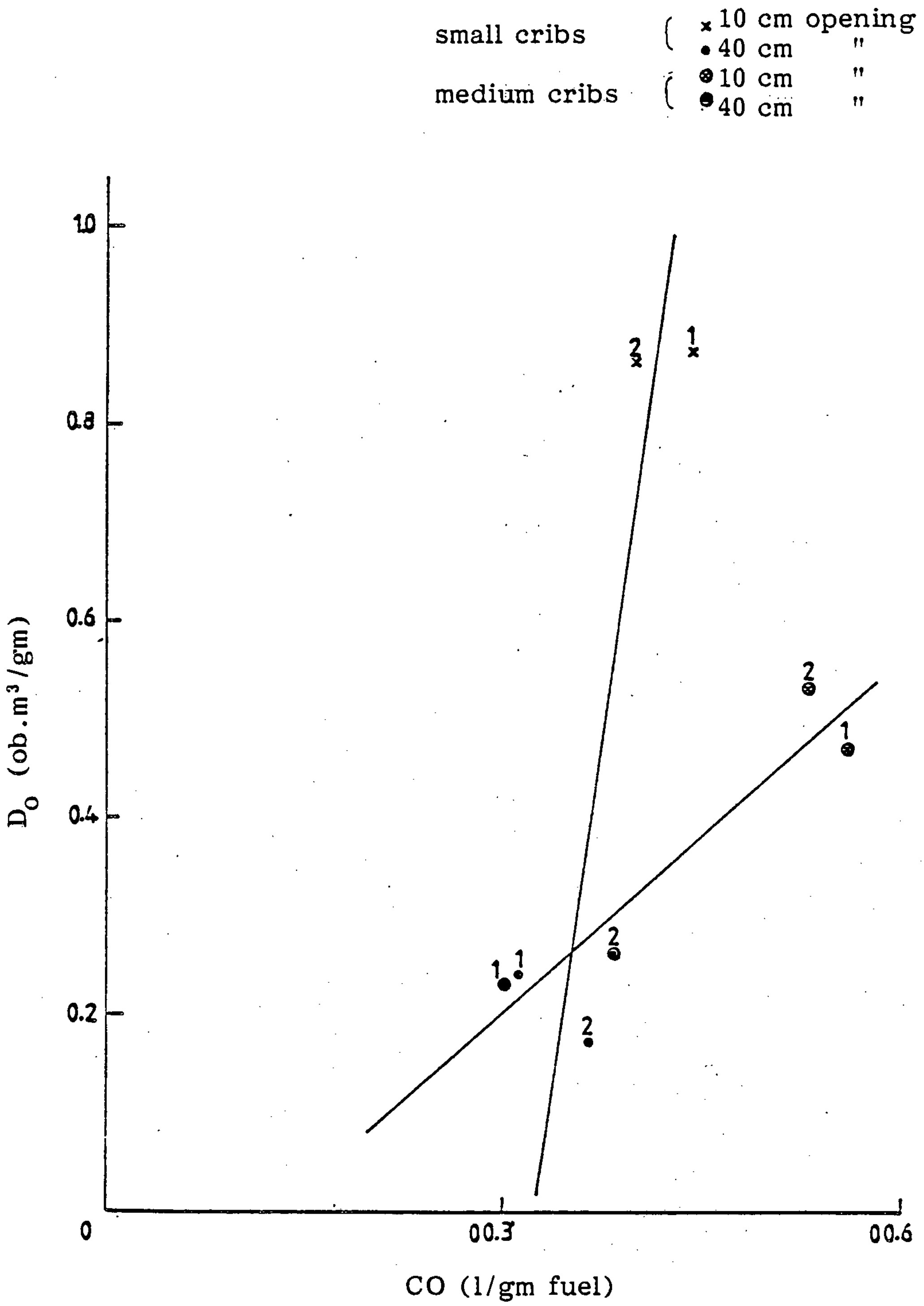


FIGURE 5.22: Relationship between D_o and CO.

Total amount of CO Vs total amount of CO_2 produced during the fire is plotted in Figure 5.23, the relation seems not clear.

As the rate of burning is temperature dependent, it was noticed for wood cribs that as the maximum temperature was reached, the smoke measured by static method was in its early stages, while for dynamic measurements, the situation was different as both maximum temperature and obscuration were reached almost at the same time. This is due to the time delay for the smoke to be detected by the detection beam (Table 4.26). For the plastics, because the flame and the smoke appeared vigorously at nearly the same time, the maximum temperature and obscuration were recorded almost simultaneously in both static and dynamic measurements.

In the EU chamber test, as the heat flux level increased, the D_O for both PMMA and white pinewood was increased. These two measurements were plotted against each other in Figure 5.24 a and b. The radiation Vs the D_O(static) from the compartment fire (box only) and for the different ventilations is plotted in the same figures. Both materials tested in the fire compartment showed the same trend as in the EU test (D_O increased when the radiation level was increased). A higher increase was seen in D_O when the radiation level increased in the fire compartment than in the EU test, which is probably due to other parameters in the test, especially the ventilation, as reduced ventilation increased the smoke yield (a factor of 4 with small cribs and of 3 for medium cribs). As the heat output is dependent on the rate of burning, which is not increased significantly for small and medium cribs, it can be taken as evidence that the difference in D_O is due to the reaction of the volatiles within the fire compartment under condition of reduced oxygen concentration (imbalance of pyrolysis-

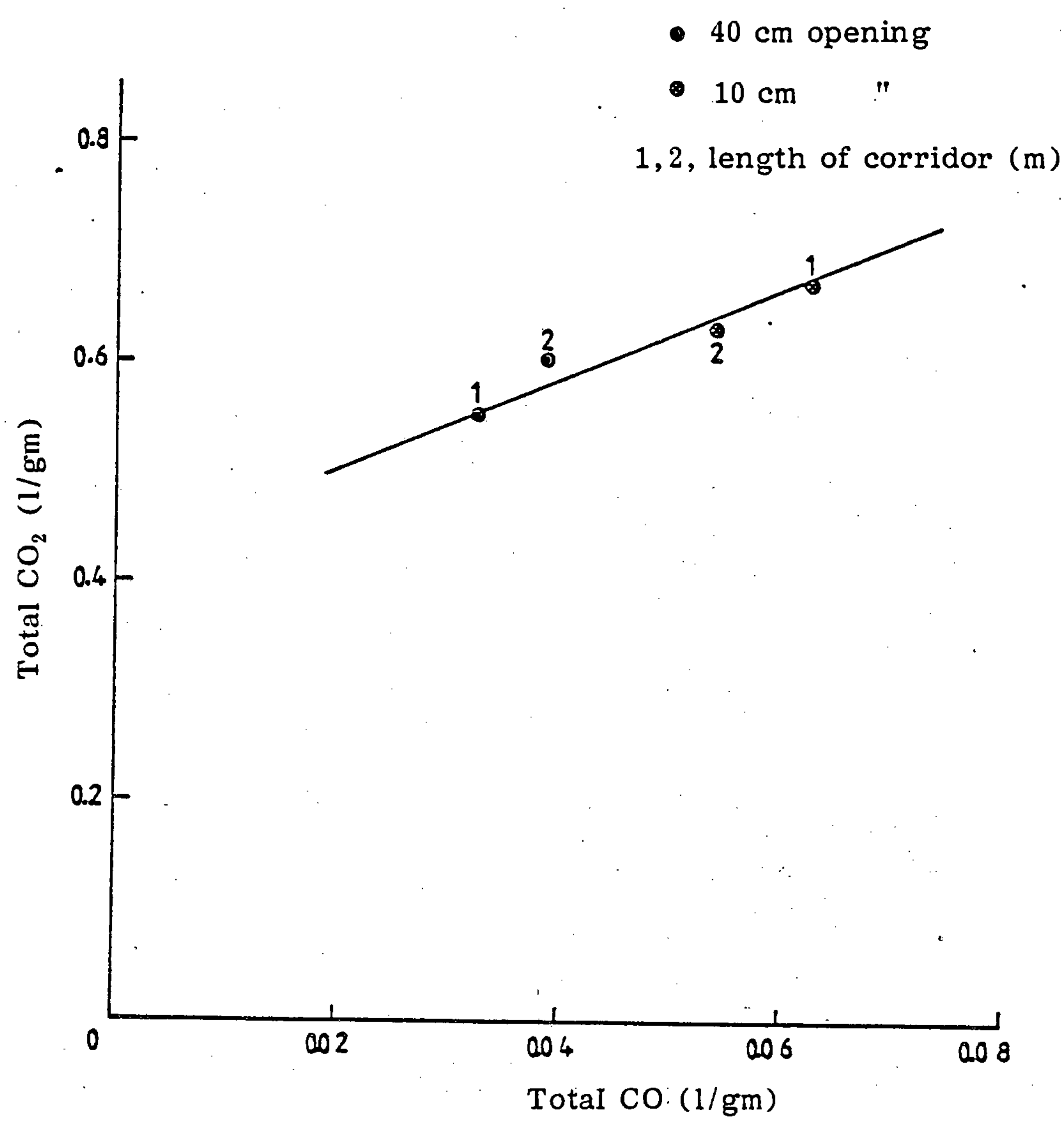


FIGURE 5.23: Comparison of total CO and CO_2 produced during fire of medium cribs.

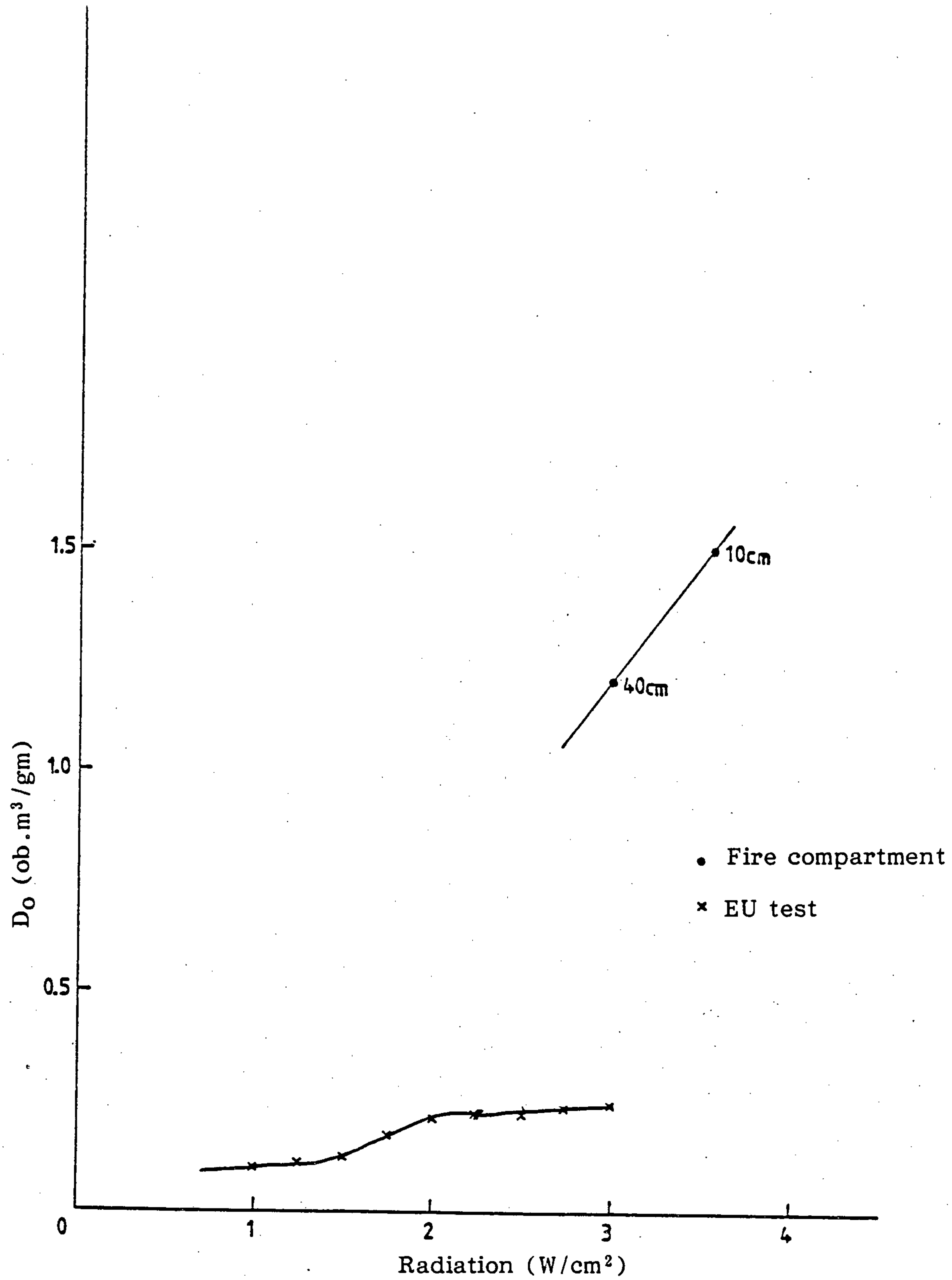


FIGURE 5.24(a): Variation of D_O with radiation for PMMA.

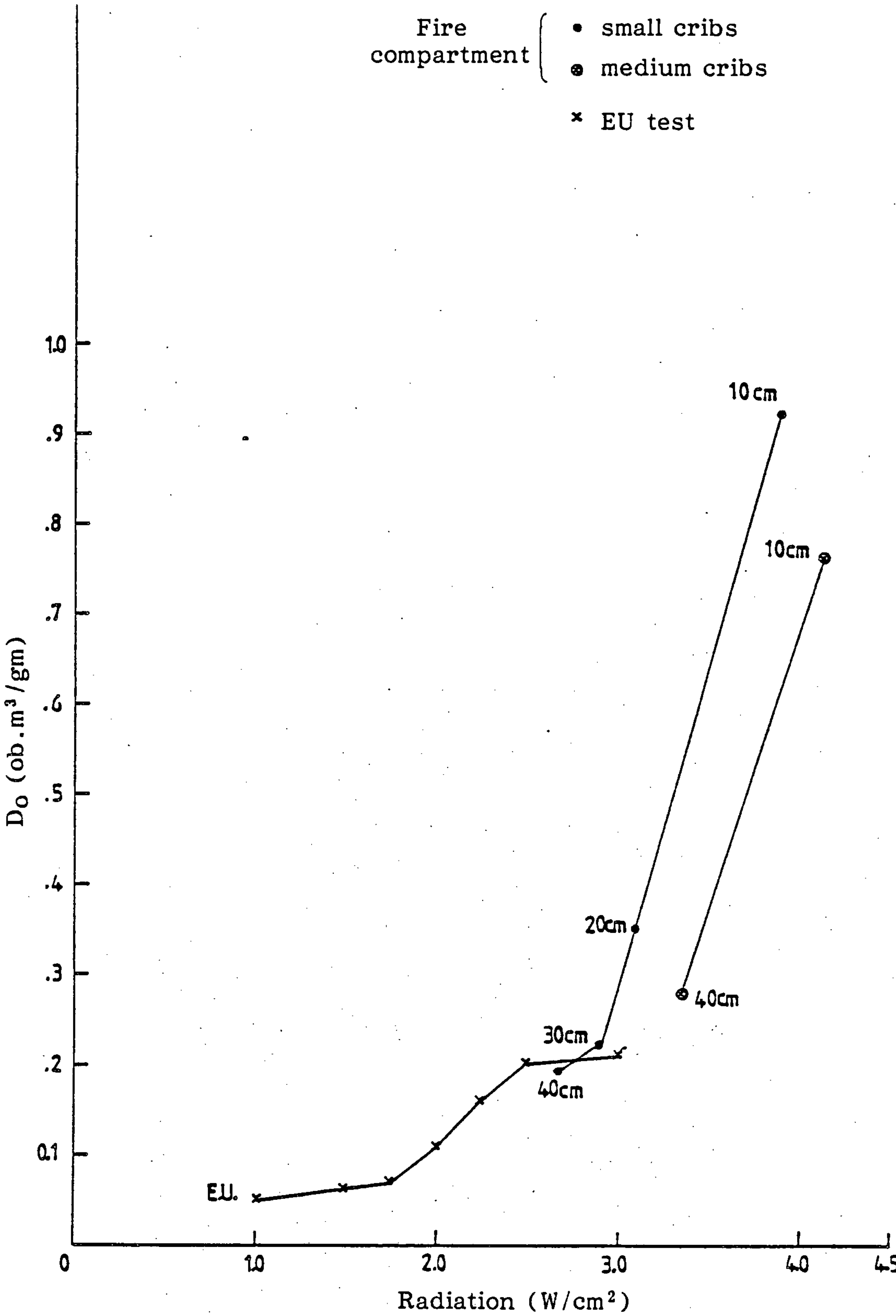


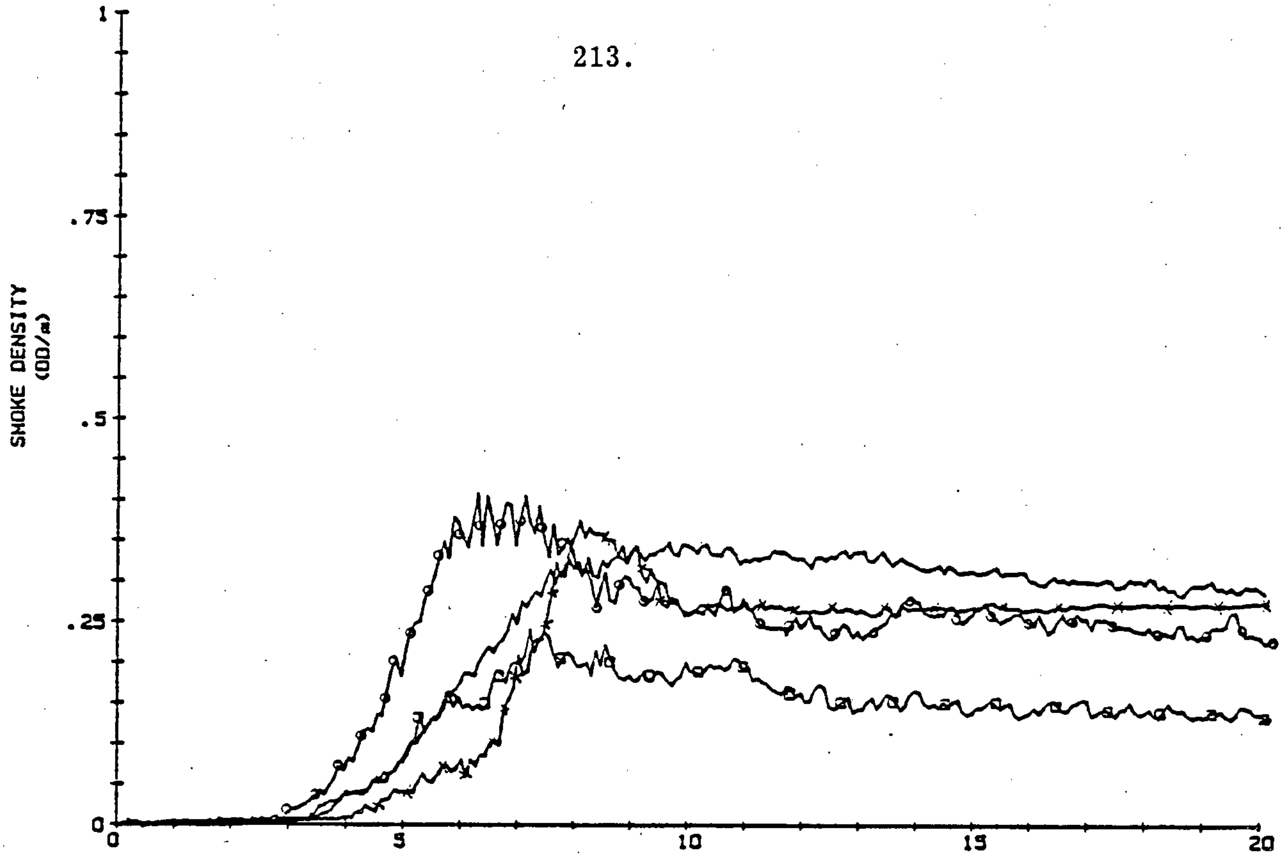
FIGURE 5.24(b): Variation of D_O with radiation for pine wood.

oxidation). Another parameter recorded was the time to the maximum obscuration which is fire load dependent and not affecting the corridor (for wood and plastics). The plastics had a longer t_m when free burning than when inside the box (Table 4.26) which was mainly due to the effect of radiant feedback when the sample was burning inside the box. This behaviour was not so clear for the wood, which may be due to the formation of a protective layer of char and also to the structure of the crib which shields the inner surface from the radiation feedback.

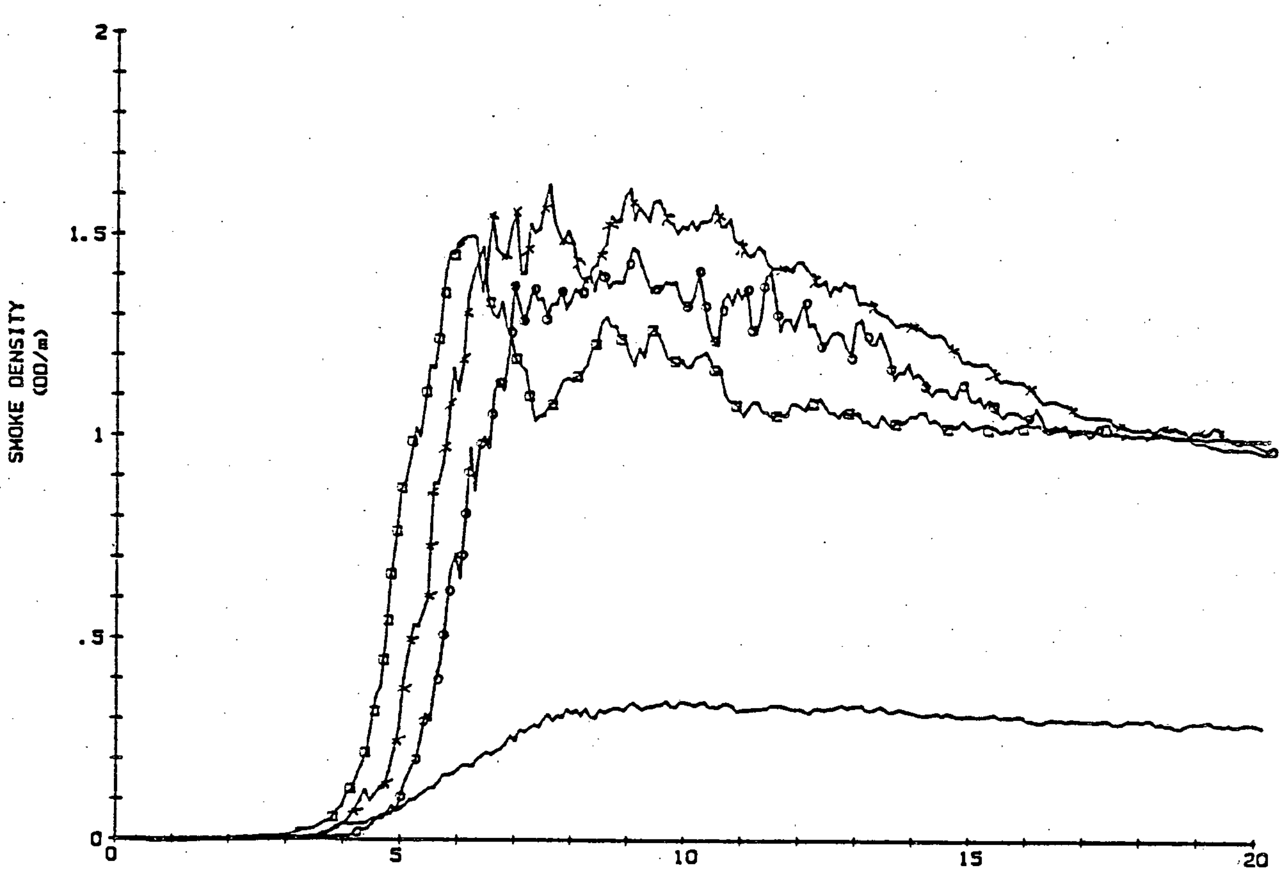
5.1.4.4 Ageing of the smoke

This project deals only with the conventional measurement of the smoke and no work has been done to measure the shape and the size of the particles which are likely to influence the ageing of the smoke for the various tests. In the small scale room corridor experiments, smoke was left to mature after burning stopped, although the time depended on how quickly the material burned, as every experiment whatever the test was stopped at the end of twenty minutes (Figure 5.25 to 5.29). Table 4.27 shows the percentage of the reduction in the optical density from the maximum obscuration at the end of 20 minutes. A short term ageing process is observed in this time. This short term decay takes 3-5 minutes. As all values of t_a (the time between maximum obscuration and end of 20 minutes) were greater than 5 minutes, a direct comparison of the per cent reduction gives an approximate comparison of the decrease in D_o due to short terms. There are not enough data for comparison as the results are scattered. More data are required.

It was not possible to wait for long term ageing as the use of the test room at Gullane was limited.

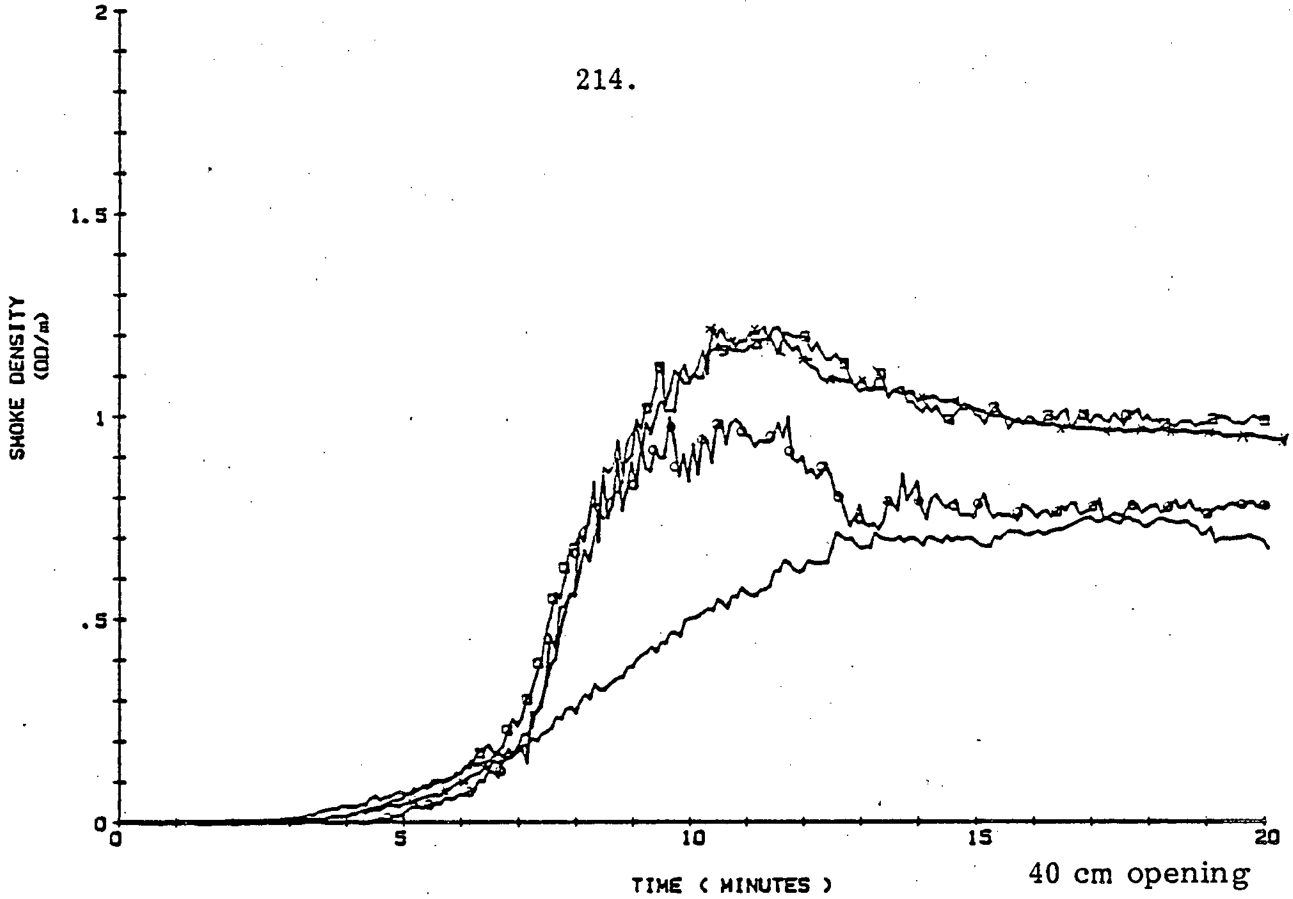


40 cm opening



10 cm opening

FIGURE 5.25: Ageing of the smoke for small cribs.
(Free burning ——, box x—x, 1 m corridor o—o,
2 m corridor □——□)



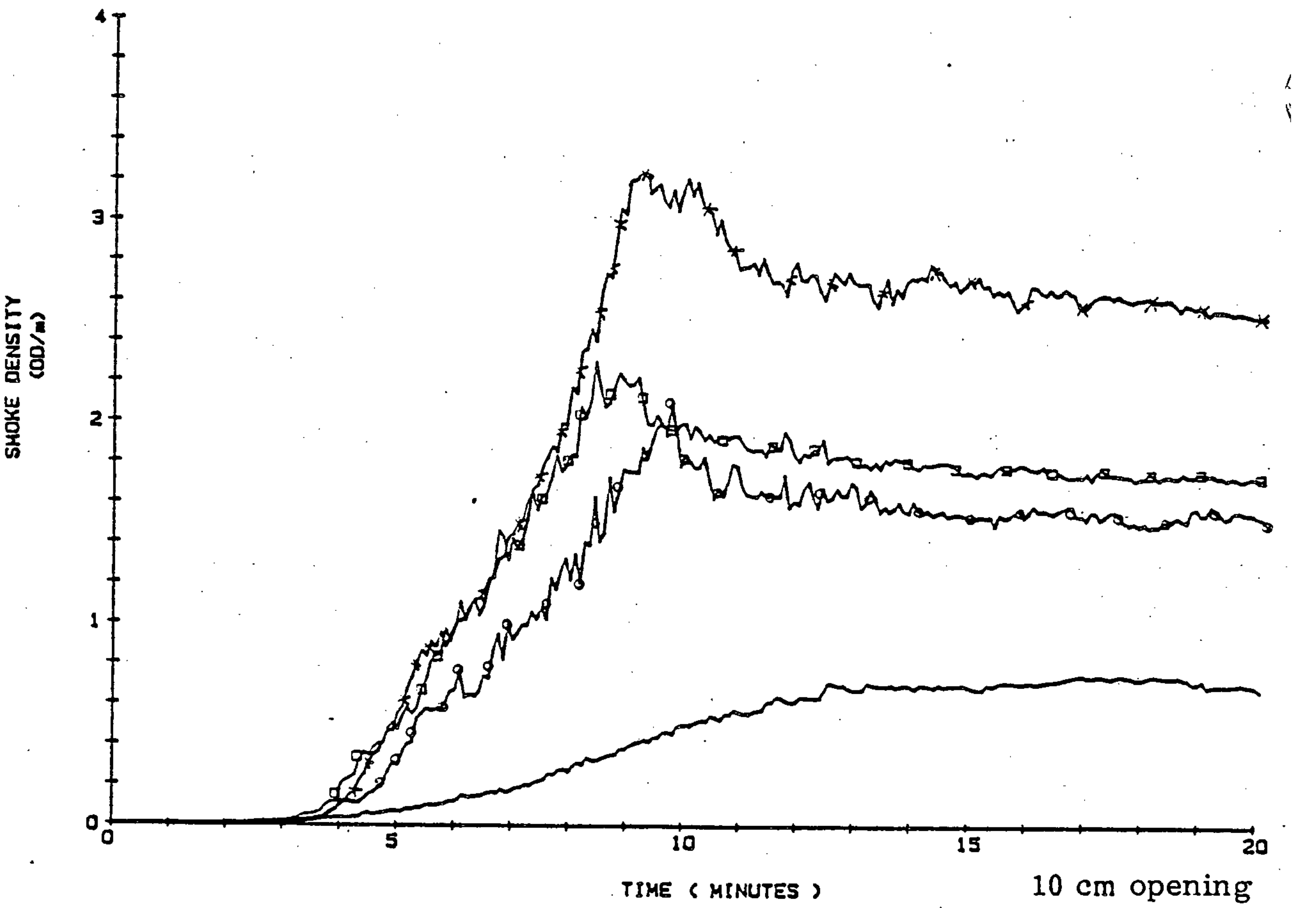


FIGURE 5.26: Ageing of the smoke for medium cribs.

(Free burning ——, box x—x, 1 m corridor o—o,
2 m corridor □—□)

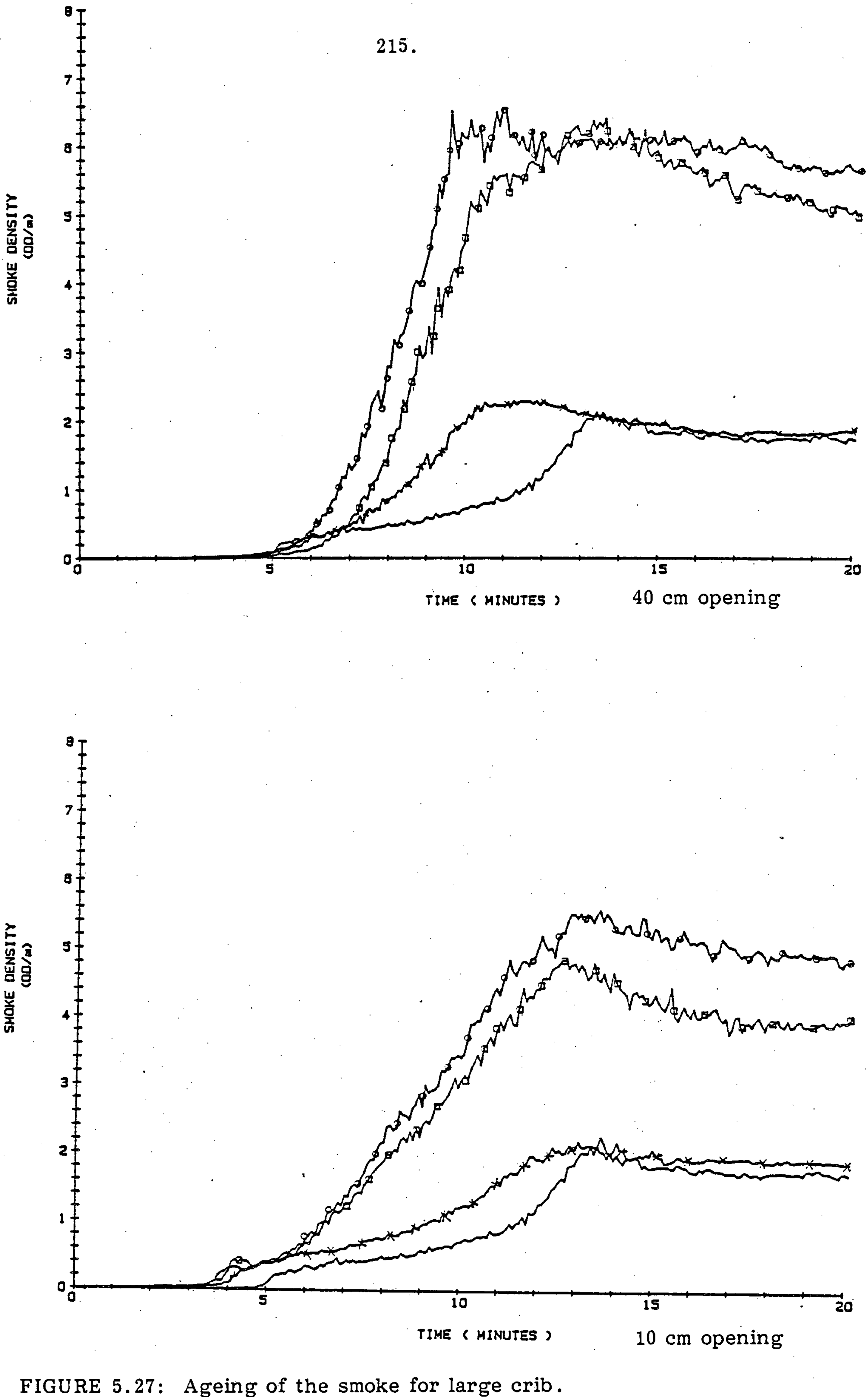


FIGURE 5.27: Ageing of the smoke for large crib.
(free burning ——, box x—x, 1 m corridor o—o,
2 m corridor □—□)

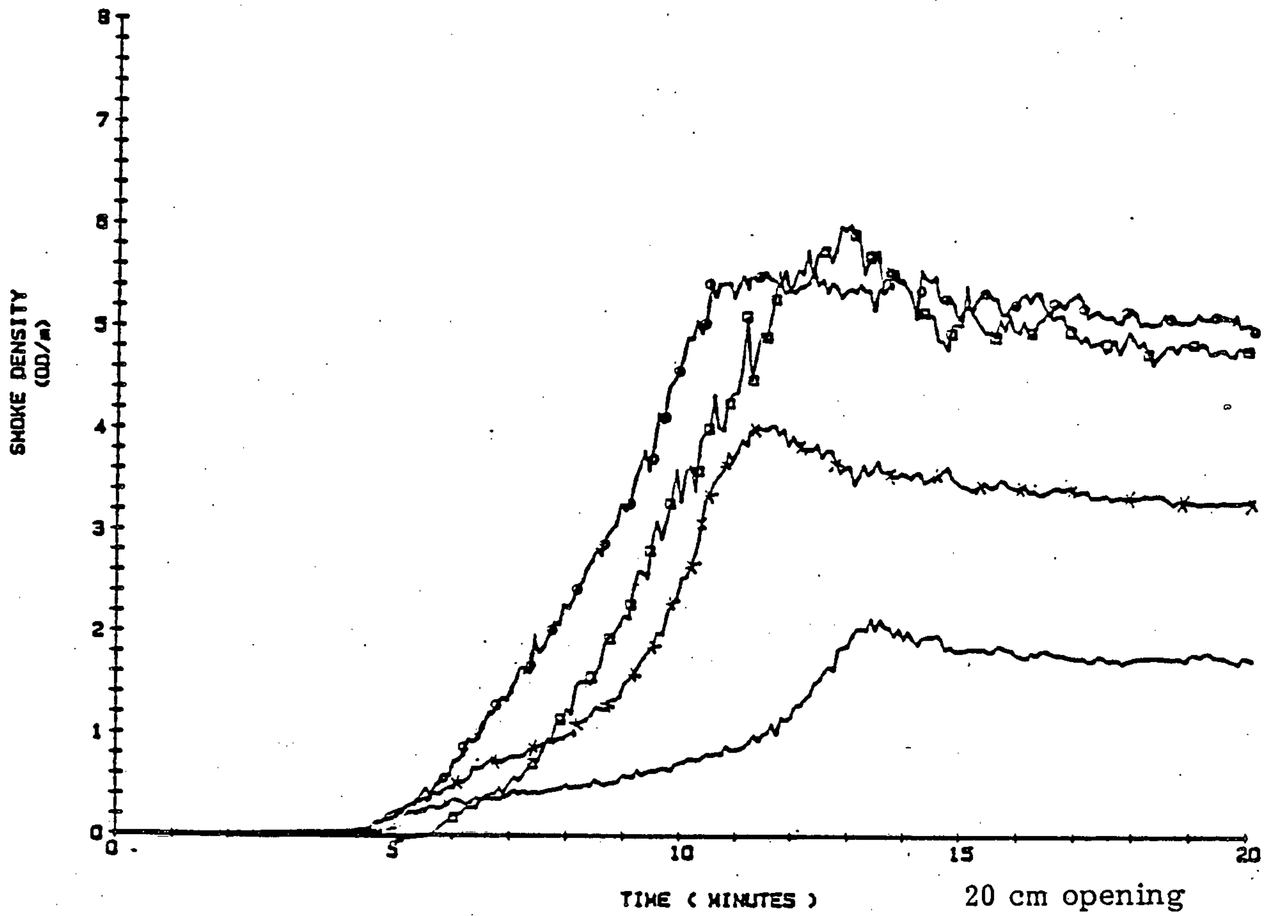


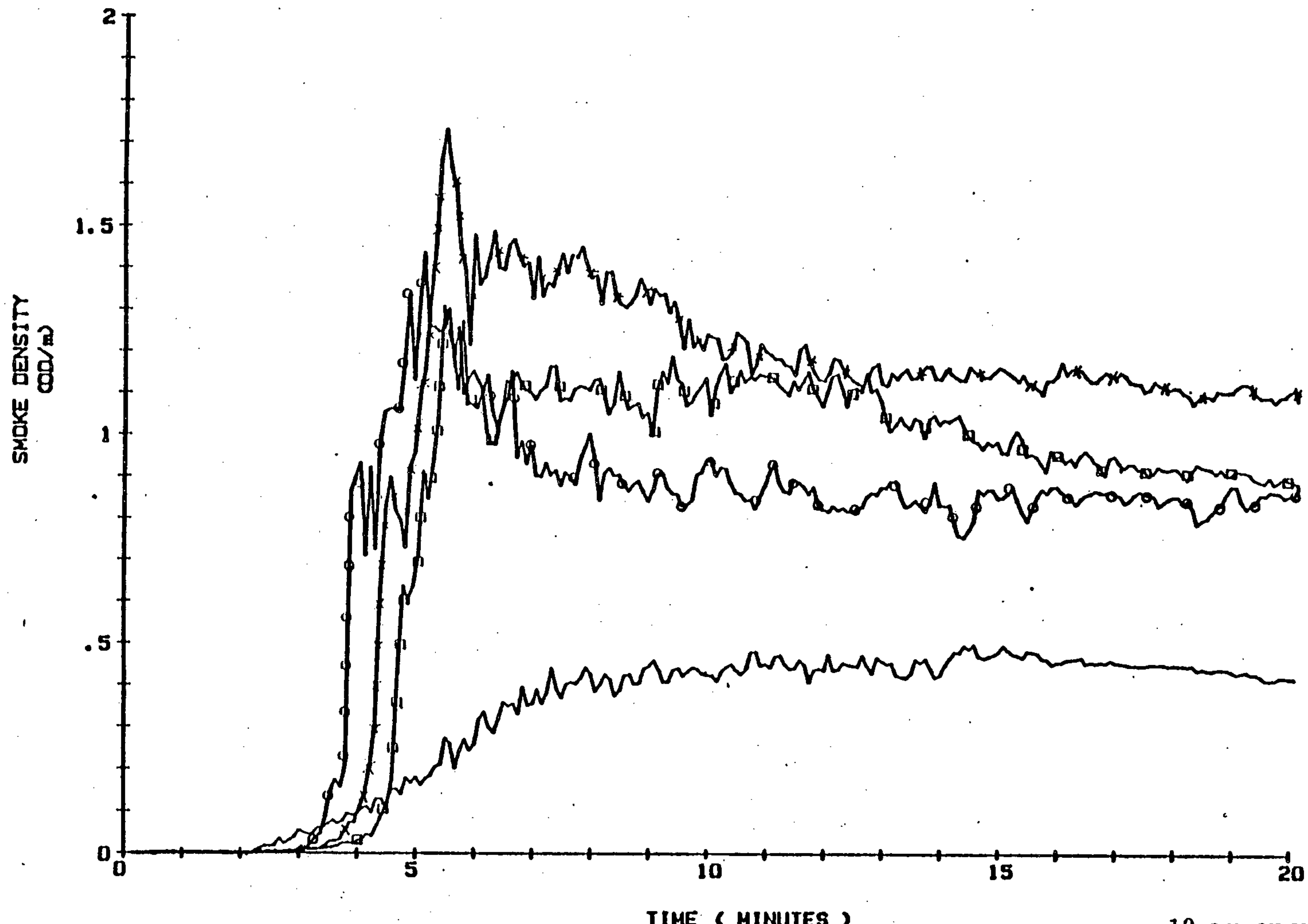
FIGURE 5.27: Ageing of the smoke for large cribs (continued).

——— free burning

x—x—x box only ,

o—o—o with 1 m corridor

□—□—□ with 2 m corridor



10 cm opening

FIGURE 5.28: Ageing of the smoke for PMMA.
(Free burning ——, box x—x, 1 m corridor o—o, 2 m corridor □—□)

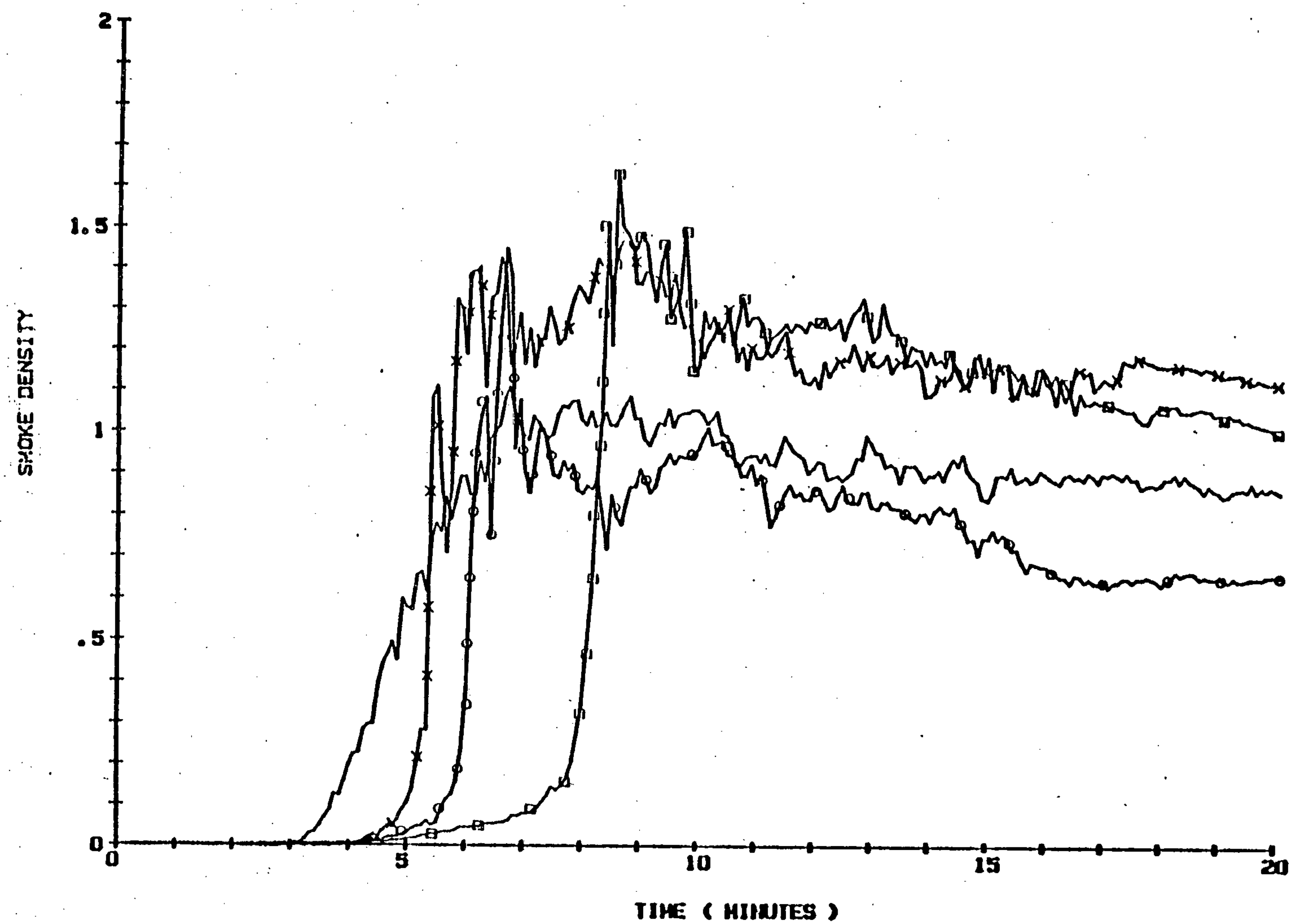


FIGURE 5.29: Ageing of smoke for polypropylene.
(Free burning ——, box x—x, 1 m corridor o—o, 2 m corridor □—□).

The effects of ventilation of the fire compartment on the ageing of smoke is not consistent, as it increased significantly for small and medium cribs when the ventilation decreased from 40 to 10 cm, while for large cribs there was no significant change. Unfortunately, there are not enough results for the plastics to study the effect of ventilation. The apparently large reduction of the smoke yield by short time ageing for plastics might be due to the fact that all these results refer to restricted ventilation. For PP, one of the results in smoke reduction was 47%, but there was a high speed wind on the day of the test which might have affected their results.

5.2 Comparison of the results

The comparison between the EU and the fire compartment tests is given in Section 5.1.4

5.2.1 NBS and EU chamber tests

The idea behind developing a modification of the NBS chamber in Edinburgh (Phillips, 1976) was to allow the smoke to accumulate inside the larger chamber, and to avoid oxygen depletion.

The comparison of the results for both tests is presented in Table 5.9 a and b. The difference between the two systems will be discussed first. The main differences are:

(a) The volume of the EU chamber is 13.75 m^3 compared with 0.51 m^3 for the NBS chamber.

(b) The obscuration device. Photocell was the same, but the path length is 2.2 m for the EU test and 0.9 m for the NBS chamber. In the NBS test the light beam traversed the total height of the chamber, while in the EU chamber the light source was 5 cm above the floor.

TABLE 5.9a: NBS and EU results - comparison - flaming.

Material	D (ob)		D_o (obm³/gm)		D_s		t_m (min)		% Weight loss	
	E.U	NBS	E.U	NBS	E.U	NBS	E.U	NBS	E.U	NBS
Plywood	0.17	7.1	0.1	0.15	55	86	19.1	15.2	66	64
White pine wood	0.32	17.1	0.2	0.40	104	206	12.5	16.6	72	69
Fibreboard	0.08	0.46	0.09	0.03	26	5.6	9.6	3.8	71	41
Hardboard	0.20	4.0	0.2	0.15	68	49	6.0	4.8	78	75
Heavy black foam	0.06	9.2	0.2	1.2	20	110	6.8	7.2	16	16
Light black foam	0.03	7.0	0.2	1.1	9	84	3.0	8.0	13	22
Blue foam	0.03	12.5	0.5	2.9	11	150	1.0	8.8	33	84
Yellow foam	0.035	10.6	0.43	3.7	11	128	1.0	8.0	69	89
Flexible foam	0.043	10.6	0.52	4.2	14	127	2.7	8.7	50	83
Additive foam	0.091	14.8	1.38	3.2	30	179	1.0	7.7	38	86
PMMA	0.49	4.2	0.22	0.1	51	51	14.0	6.2	98	71
Polystyrene	1.53	6.17*	2.31	4.38*	498	745*	6.6	-	50	79*
Polypropylene	0.10	6.40*	0.33	2.62*	34	773*	4.9	-	27	98*
PVC	3.01	4.16*	2.35	2.38*	980	502*	11.7	12.0*	71	56*
ABS	4.41	4.97*	3.77	1.43*	1436	600*	7.3	-	86	54*

*From D. Christian (1984).

TABLE 5.9b: NBS and EU tests - comparison - non-flaming.

Material	D (ob)		D_o (obm³/gm)		D_s		t_m (min)		% weight loss	
	E.U	NBS	E.U	NBS	E.U	NBS	E.U	NBS	E.U	NBS
Plywood	2.7	40.1	1.3	1.1	879	483	23.1	17.2	78	46
White pine wood	4.62	58.6	2.4	1.7	1491	706	24.8	19.5	79	57
Fibreboard	1.67	42.3	1.83	1.9	543	510	12.0	10.2	73	60
Hardboard	3.10	53.2	2.8	2.3	1009	640	15.8	12.2	88	65
Heavy black foam	0.32	8.1	0.4	0.7	104	97	32.9	13.50	44	25
Light black foam	0.20	6.1	0.6	1.0	65	73	19.9	9.4	32	21
Blue foam	0.62	11.1	5.4	4.5	201	133	37.9	19.3	61	49
Yellow foam	0.62	16.2	6.1	6.9	200	195	19.4	12.2	85	73
Flexible foam	0.54	10.4	6.55	6.6	175	125	21.0	17.0	65	52
Additive foam	0.60	15.9	5.5	5.8	190	192	11.7	10.0	61	52
PMMA	0.12	7.5	0.06	0.16	39	90	20.0	25.0	78	66
Polystyrene	2.49	2.73*	4.56	2.37*	809	329*	50.2	-	41	19*
Polypropylene	3.15	4.51*	5.58	2.7*	1024	544*	42.5	-	50	65*
PVC	2.77	2.57*	2.15	2.22*	903	310*	33.5	18.0*	71	39*
ABS	4.25	4.00*	6.39	1.65*	1384	483*	30.9	-	49	45*

*From D. Christian (1984).

(c) The heater used in EU was 0.18 m in diameter, while for NBS it was 0.076 m.

(d) In the EU test, six parallel horizontal jets were used for flaming combustion, and the specimen holder did not have a trough to collect molten polymer (Section 3.1.2). The NBS (Section 3.1.1.5) burner had multidirectional jets and the sample holder had a trought.

(e) The difference in the thermal mass (properties) of the sample holders in the two tests. This may be one of the important differences which is affecting the results because of the difference in the heating of the holder and the transfer of heat through it.

The points of difference mentioned above may all influence the results in their own way. To make a comparison, using Phillips (1976) suggestion, if results for a given material by two methods are within a factor of 1.5 of each other, the agreement is said to be "good". When the agreement is less good but within a factor of "2", it may be said to be "fair". Applying this rule, the results show a good agreement for three materials under flaming conditions and nine materials under non-flaming conditions. As a group, the results for the cellulose materials were in better agreement than those for the synthetic materials. This may be due to the dripping and melting effect of the plastic foam and solid plastic. Under flaming conditions, foam tested in the NBS chamber gave values of D_O, much greater than those obtained in the EU chamber. This may be due to the difference in the burners and the presence or absence of the trough, as all the materials melt and drip. In addition to this difference in the burner, is the condensation effect inside the smaller NBS chamber.

The behaviour for solid plastics under flaming conditions was similar to that of foams, i.e. D_o was higher in NBS than in EU. The exception to this was PMMA for which both D_o and weight loss were less in the NBS. The reason for this may be the same as for the higher D_o in the foam tests (part of the sample was under non-flaming condition with multidirectional burner), as the PMMA gave less smoke under non-flaming condition, so the D_o was higher for the EU than for the NBS test (see Chapter IV).

In the recommended procedure for the NBS chamber, the test should be continued until maximum obscuration value is reached or after an exposure of 20 minutes, whichever occurs first. For the EU chamber, the test was left to reach maximum obscuration regardless of the time taken. This procedure was also adopted for the NBS test for the purpose of this project.

The results for four thermoplastic materials (polypropylene, polystyrene, PVC and ABS) were taken from the work of Christian (1984) (Table 5.10), who followed the standard procedure for the

TABLE 5.10: Results of NBS test by D. Christian (1984).

Material	Combustion	D_s	Weight loss (gm)	D_o* ob.m³/gm
PVC	Flaming	501.5	13.83	2.38
PP	"	772.5	15.56	2.62
PS	"	>745.0	14.35	4.38
ABS	"	>600.0	10.12	1.43
PVC	Non-flaming	309.5	9.87	2.22
PP	"	543.8	10.27	2.70
PS	"	329.0	3.42	2.37
ABS	"	483.3	8.40	1.65

*Calculated by the author of this thesis.

maximum obscuration on the 20 minutes time. In the EU test these four materials (thermoplastic) under non-flaming conditions took more than 30 minutes to reach the maximum obscuration and this may be the explanation for the higher D_o in the EU than in the NBS test.

5.2.2 NBS test with Arapahoe test

Several methods have been used to relate the gravimetric smoke results (Arapahoe) to the optical results (NBS).

Work by Seader and Ou (1974) lead to a generalized method applicable to a wide variety of materials, using the theory of light attenuation by scattering and absorption together with the particle mass concentration and the optical density as follows:

$$D = 10(\text{POD})\,C_s \qquad \ldots (5.5)^1$$

Where D is the optical density per metre (bel), C_s is the mass concentration of particles (gm/cm^3) and POD is the particulate optical density = 33,000 (cm^2/gm).

According to Ou and Seader (1977/78) concentration of particles C_s can be determined from the percentage smoke value in the Arapahoe chamber and the weight loss with optical method as follows:

$$C_s = \frac{\Gamma' M}{V} \qquad \ldots (5.6)$$

Where $\Gamma' = M_p/M_a$; M_p = smoke particulate mass determined in the Arapahoe chamber; M_a = airborne mass loss in the Arapahoe chamber;

[1] When D = 1 bel/m and POD = 33,000 cm^2/gm, then from equation 5.5 C_s will equal 3.3×10^{-5} mg/cm^3 = 0.3 gm/m^3. This is in a good agreement with Shore *et al.* valuation for smoke concentration (see page 203).

M = airborne mass loss of the specimen as measured in grams in the NBS chamber; V = volume of the NBS chamber. Table 5.11 shows the value of Γ', C_S and D for all the materials tested.

TABLE 5.11: Comparison of Arapahoe and NBS.

Material	Γ'	M (gm)	C_S	$D_{(ob)}$
Plywood	0.0051	24.14	0.240	7.1
Pinewood	0.0109	22.80	0.487	17.1
Fibreboard	0.0071	7.80	0.108	0.5
Hardboard	0.0043	13.60	0.114	4.0
Heavy black foam	0.1583	3.91	1.214	9.2
Light black foam	0.0493	3.25	0.314	7.0
Blue foam	0.1150	2.20	0.496	12.5
Yellow foam	0.1198	1.46	0.343	10.6
Flexible polyurethane	0.1518	1.29	0.384	10.6
Additive foam	0.1138	2.36	0.527	14.8
PMMA	0.0029	21.42	0.121	4.2
PS	0.1205	7.14	1.689	55.5
PP	0.0955	9.28	1.738	59.4
PVC	0.0850	10.58	1.763	41.5
ABS	0.1030	6.94	1.401	49.2

The values of D are plotted Vs C_S in Figure 5.30, which includes the correlation line for (POD) equal to 33,000 cm^2/gm as obtained by Ou and Seader (1977/78). Generally speaking, all points fall reasonably close to the correlation line and agree well with the results obtained by King (1975) except for fibreboard and the heavy black foam.

Spark and Legg (1977) derived an equation for the prediction of specific optical density by arrangement of equation 5.5 and 5.6 and substitution of the appropriate value for POD, V, C_S, yielding the following equation:

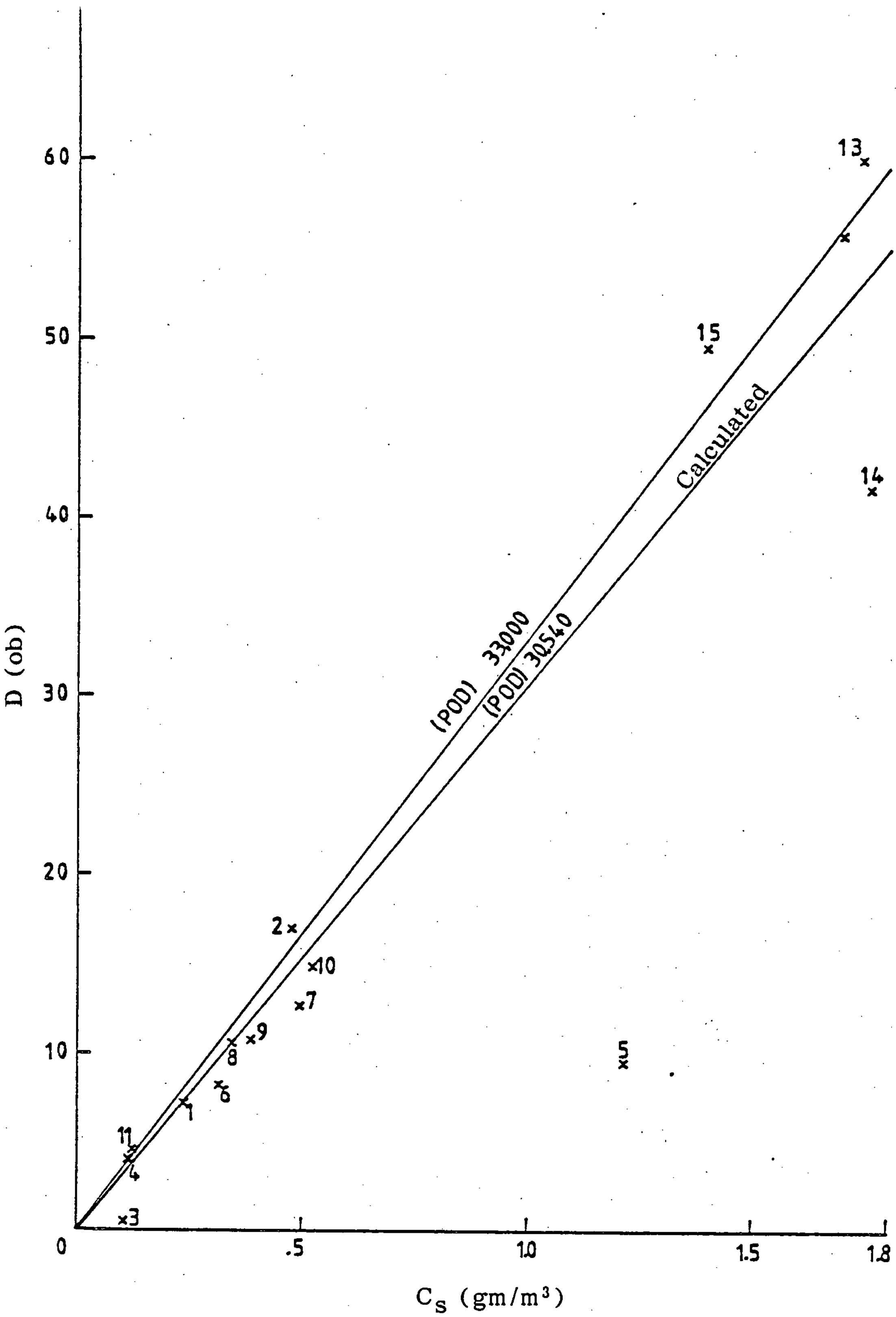


FIGURE 5.30: Calculated (POD).

$$D = 7.8\,(M)\,(\Gamma') \qquad \ldots (5.7)$$

Figure 5.31 shows good agreement for predicted vs measured optical density except for fibreboard and heavy black foam.

Hilado *et al.* (1977) found a relation between the results from the Arapahoe and the NBS test under non-flaming conditions from four materials (Figure 5.32a). They admitted that there was no logical explanation for this relation. They studied only four materials, which give a very high possibility of a chance result. There is no correlation found in the results of this project. Hilado *et al.* (1977) did not find any effective correlation between the Arapahoe test and the NBS test under flaming condition (Figure 5.32b).

5.2.3 Edinburgh test with Arapahoe test

Poor or no correlation between the two is noticed when equation 5.4 is applied to the EU test. The results are tabulated in Table 5.12. The average calculated (POD) is 11,600 compared with 30,500 for the NBS test. Only four materials fall in between 18,000 and 40,000 recorded by Ou and Seader (1977/78). The reason for this lack of correlation is not known but may be due to the differences in the rate of condensation and coagulation in the NBS and EU test chambers (Figure 5.33; from Seader and Chien [1974], the growth of smoke droplet by coagulation, this can lead to different optical density, thus the D_o).

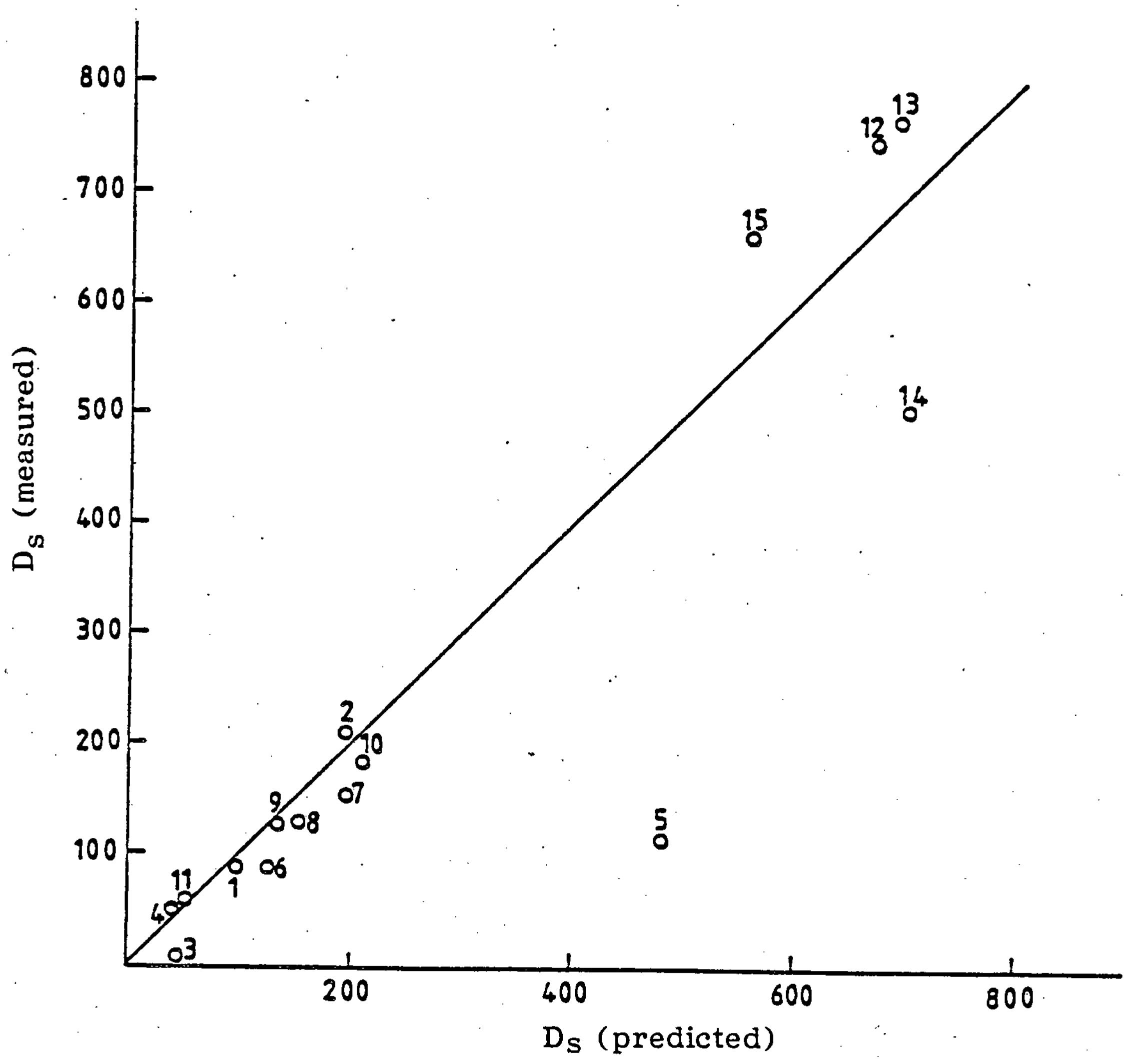


FIGURE 5.31: Comparison of D_S measured, and D_S predicted.

(1 = plywood; 2 = pinewood; 3 = fibreboard; 4 = hard-board; 5 = heavy black foam; 6 = light black foam; 7 = blue foam; 8 = yellow foam; 9 = flexible foam; 10 = additive foam; 11 = PMMA; 12 = PS; 13 = PP; 14 = PVC; 15 = ABS)

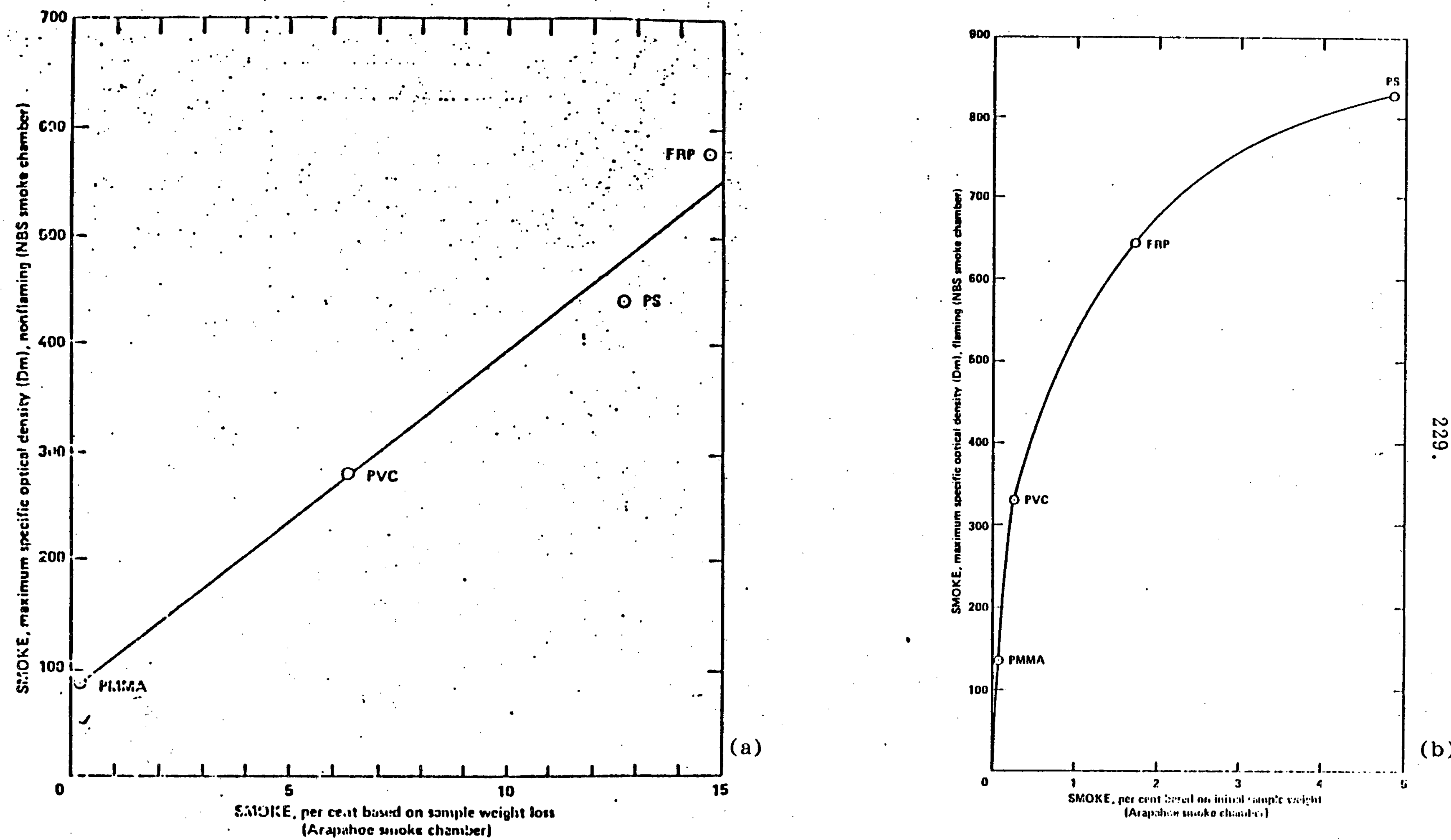


FIGURE 5.32: Comparison of NBS test results and Arapahoe results (Hilado, 1968).
(a) non-flaming; (b) flaming.

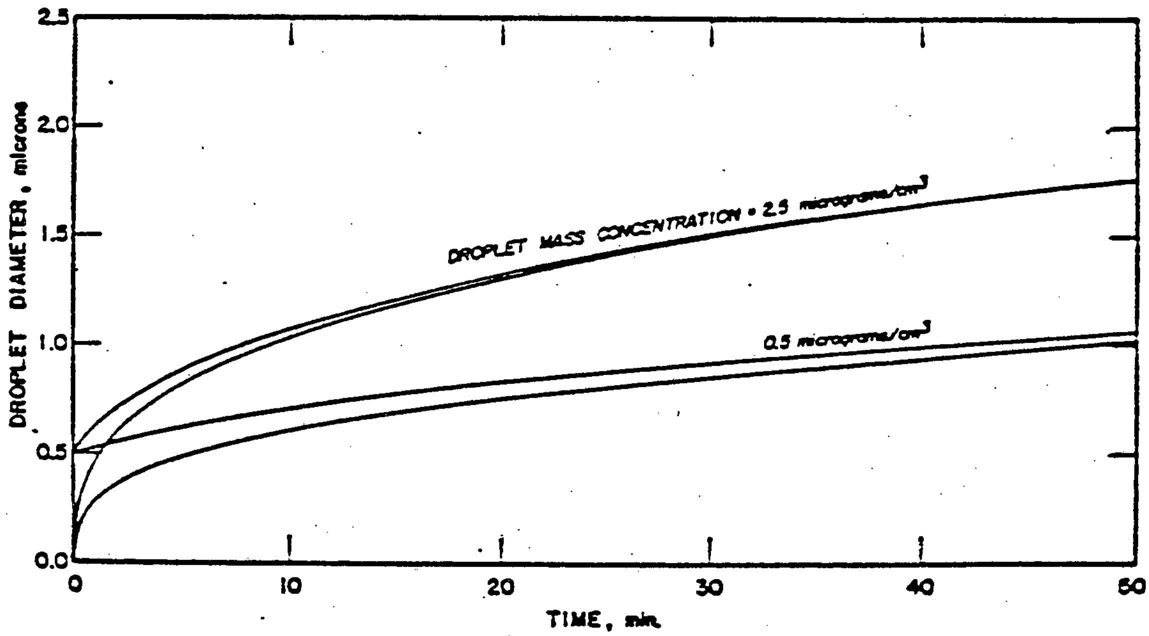


FIGURE 5.33: Effect of coagulation on growth of droplets.

TABLE 5.12: Arapahoe and EU comparison.

Material	C_s (gm/m³)	$D_{(ob)}$	(POD)
Plywood	0.0186	0.170	9,130
White pine	0.0174	0.320	18,350
Fibreboard	0.0063	0.080	12,740
Hardboard	0.0043	0.200	46,730
Heavy black foam	0.0476	0.060	1,259
Light black foam	0.0067	0.030	4,511
Blue foam	0.0074	0.033	4,484
Yellow foam	0.0098	0.035	3,590
Flexible foam	0.0128	0.044	3,446
Additive foam	0.0075	0.090	11,984
PMMA	0.0064	0.490	76,087
PS	0.0800	1.530	19,185
PP	0.0295	0.103	3,489
PVC	0.1087	4.120	36,588
ABS	0.1205	4.410	37,899

5.2.4 *Arapahoe and fire compartment*

Arapahoe results for pinewood, PMMA and PP can be compared with results from compartment fire. The per cent smoke based on weight loss for the three materials tested by the fire compartment method are calculated by converting the optical density to gm/m³ smoke (optical density of 1 bel/m corresponds to a smoke concentration of 0.33 gm/m³; Shore *et al.*, 1952), and as follows:

$$X \text{ optical density} \times 0.33 = Y \text{ gm/m}^3 \text{ smoke}$$

$$Y \times \text{volume (test room)} = W_S \text{ gm weight of smoke}$$

$$\text{then} \quad \frac{W_S \text{ gm} \times 100}{\text{Weight loss (gm)}} = \%\text{ smoke based on weight loss}$$

Table 5.13 shows this comparison.

TABLE 5.13: Comparison of Arapahoe test with fire compartment method.

	% Smoke based on weight loss	
Fuel bed	Arapahoe test	Fire compartment method (40 cm)
Pinewood	1.05	0.80
PMMA	0.29	1.60
PP	9.55	11.40

The results are in reasonable agreement for wood and PP only.

5.2.5 *NBS and fire compartment*

The comparisons for the three materials tested in fire compartment and NBS tests (white pine, PMMA and PP) are set out in Table 5.14.

TABLE 5.14: Comparison - NBS test and fire compartment test.

Material	NBS test D_O (ob.m^3/gm)	Fire compartment method (free burning) D_O (static)
Wood	0.40	0.20
PMMA	0.10	0.48
PP	2.62	3.43

The results varied from one material to the other. The significant difference is in the PP results. Those from the EU test and fire compartment method in the ratio of 1 : 10, while for the NBS test the ratio was 3 : 4. For PMMA, in both EU and NBS tests the smoke potential was less than that of the fire compartment, while for wood there was better agreement between the fire compartment and EU test than with NBS test.

The D_o from NBS test was also compared with D_o(dynamic) from the fire compartment with a 1 m corridor and different ventilation opening (10 and 40 cm) (Table 4.26). Although the results of D_o(dynamic) differed from D_o(static), the trend of the differences between D_o(NBS) and D_o(dynamic) fire compartment is the same for wood cribs and PMMA, but reversed for PP. This needs further investigation.

CHAPTER VI

Conclusion and Recommendations for Future Work

6.1 Conclusion

The purpose of this thesis was to compare some of the existing test methods (EU, NBS and Arapahoe tests), to investigate the relationship between smoke production and certain experimental variables (Chapter III), and to discover if these tests are relevant to the "real" fire. The results obtained show it is possible to draw the following conclusions.

6.1.1 Measuring System

The common measuring system for three of the tests (EU, NBS and the fire compartment test) involves the measurement of the light attenuation by the produced smoke. The tendency of smoke to stratify led to the use of a vertical beam instead of a horizontal one.

In contrast, the Arapahoe Chamber test used a gravimetric method for smoke measurement. It is noticed that the reproducibility of the tests measuring smoke with light beam is better than the gravimetric method. The results from the fire compartment showed considerable variation because some of the parameters are not under experimental control.

As the visibility in the smoke is the most important factor in hindering escape, so using attenuation of light is the best way of measuring smoke as it correlates with visibility, although there are some other factors which can affect this, e.g. irritation of eyes. This light attenuation measurement led to the use of "bel" as smoke measurement unit which is calculated from equation 2.1. In the fire compartment experiments, the smoke was measured by two methods (static and dynamic; Chapter V) which gave very different results. This needs more study because it will give the answer to the question of which measurement is more relevant to the real fire.

6.1.2 Mode of combustion

In EU and NBS tests, both flaming and non-flaming can be carried out, while for Arapahoe and fire compartment it is only the flaming combustion which can be tested. While Arapahoe test involves a pre-mixed flame, in the other three natural burning occurs, supported by radiation.

The results of the tests done in this thesis showed a significant difference in the smoke production (D_o) between flaming and non-flaming. However, it is always a "flaming fire" that produces smoke rapidly enough to threaten people outside the compartment of origin. Non-flaming combustion is very slow and although it is important at the developing stages, that period does not last long and normally produces a relatively small amount of smoke.

Another important difference between the four test methods is the mode of heat transfer to the fuel. In EU and NBS tests, the heat transfer is maintained by a radiant heat flux (Section 3.1.2 and 3.1.1.1), while in the fire compartment, although there is no external source of radiation, radiation from the flames, the walls and ceiling of the compartment increases as the fire develops; this is not under experimental control. Heat transfer in the Arapahoe test is mainly by convection with no radiation. It is commonly agreed that an increase in the radiation intensity increases the smoke potential. This is probably because of the increased temperature and rate of burning.

6.1.3 Ranking of the materials

Table 6.1 shows the ranking of the materials tested in each method. For EU test, NBS test and fire compartment method, the ranking is based on the D_o, while for the Arapahoe test it is based on percentage smoke

TABLE 6.1: Ranking of the materials tested.

Material	EU test F[1]	EU test NF	NBS test F	NBS test NF	Arapahoe test	Fire compartment	Combination of NBS, EU & Arapahoe (flaming)
Fibreboard	1	5	1	7	4		1
Plywood	2	4	4	4	3		3
Hardboard	3	8	3	9	2		2
White pinewood	4	7	5	6	5	1	5
Light black foam	5	3	6	3	6		6
Heavy black foam	6	2	7	2	15		8
PMMA	7	1	2	1	1	2	4
PP	8	12	10[2]	11[2]	8	3	7
Yellow foam	9	13	13	15	12		12
Blue foam	10	10	11	12	11		11
Flexible foam	11	15	14	14	14		14
Additive foam	12	11	12	13	10		13
PS	13	9	15[2]	10[2]	13		15
PVC	14	6	9[2]	8[2]	7		9
ABS	15	14	8[2]	5[2]	9		10

[1]F = Flaming; NF = Non-flaming
[2]Using data from Christian (1984)

calculated from weight loss. The general ranking for each material obtained by adding the rankings of that material from each test (EU, NBS and Arapahoe) under flaming condition. Figure 6.1 shows these relations between general ranking and each individual test. General points can be drawn from both Table 6.1 and Figure 6.1, as follows:

(a) The four cellulosic materials as a group produced less smoke under flaming conditions than the solid and foam plastics.

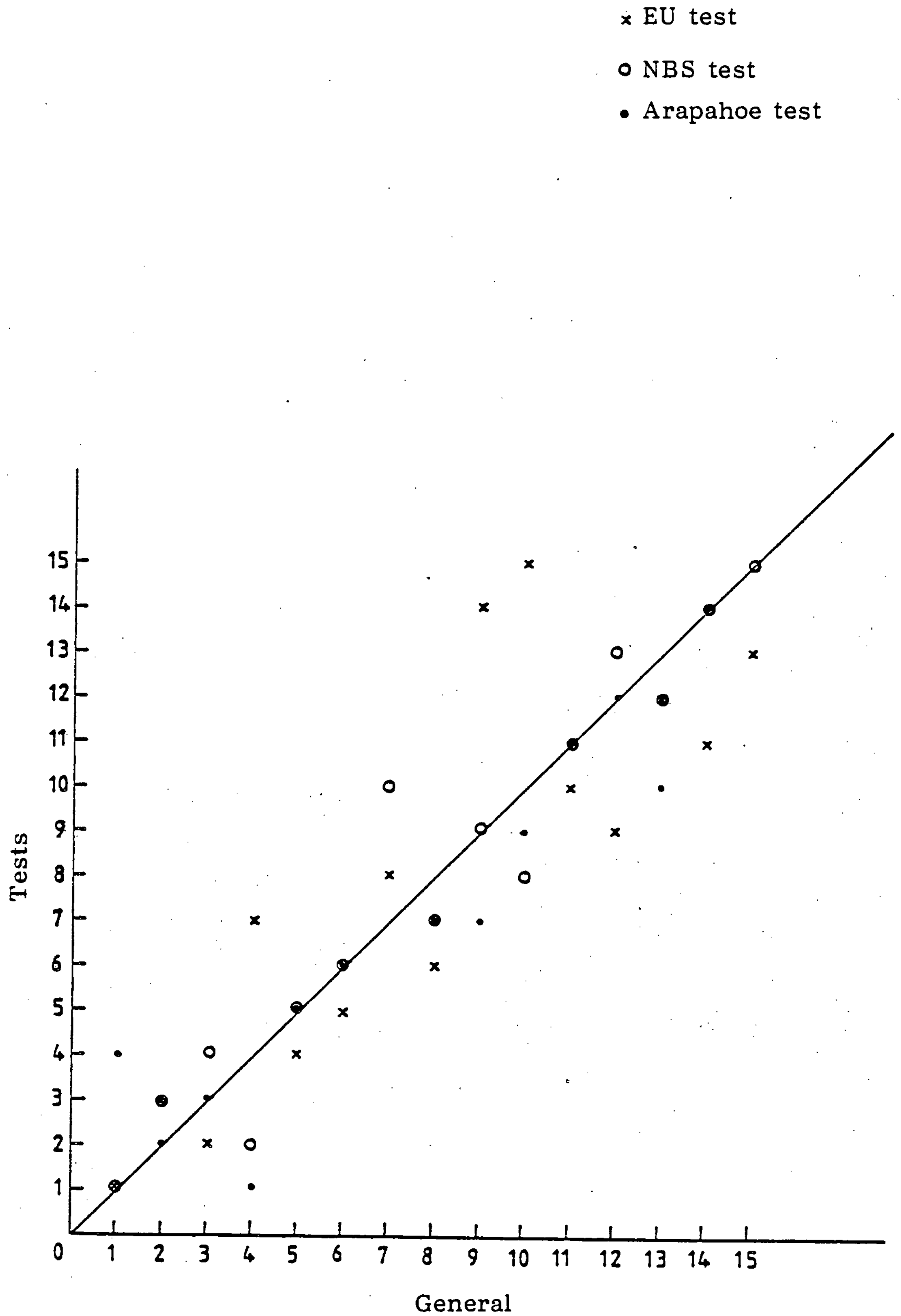


FIGURE 6.1: Comparison for the ranking of the materials tested.

(b) Although in general there is no big difference between the ranking orders of different tests, there are some exceptions, e.g. PMMA was the best in the Arapahoe test, the second best in NBS, while it was the seventh in the EU test.

(c) When the individual rankings were compared with the general one, NBS and Arapahoe are in better agreement than the EU test. Of course this is because the NBS and Arapahoe test results were in good agreement.

6.1.4 Test methods

Advantages of the laboratory test for smoke production include simplicity, reproducibility and the small size of the sample, but the relevance to the real fire is still to be resolved. The few different methods of test used in the preparation of this thesis were as follows:

6.1.4.1 NBS test

The NBS test has been used for a long time for smoke production, especially in the U.S.A. and the U.K. The apparatus is easy to use and can be operated by one person and the results are reproducible, although the apparatus is expensive. Its main disadvantage is the small volume of the chamber which may lead to oxygen depletion effects (Section 5.1.2).

6.1.4.2 EU test

The EU test is built in the same principle as the NBS test but with a much larger volume. The test is not a complicated one, gives reproducible results and is less expensive than the NBS chamber, but it is not available as a standard apparatus. It can be operated by one person but not as easily as the NBS chamber test. Generally speaking, the results followed the same trend as in the NBS test, with very good agreement between the two tests for the non-flaming condition (Table 5.11b).

6.1.4.3 Arapahoe test

The Arapahoe test involves a simple apparatus which is easy and quick to operate by one person, and gives results of fair reproducibility. It is cheaper than the NBS chamber (roughly half of the price). The results can be expressed in two ways, either based on the weight loss or on the initial weight. It is the least sensitive to changes of the experimental parameters compared with other methods. One of its disadvantages is that modifications need to be carried out for certain materials (e.g. thermoplastics) which lead to different conditions of test.

6.1.4.4 Fire compartment method

The fire compartment method represents a real fire better than the laboratory tests, but it is more complicated and more expensive to carry out. The results are less reproducible than the laboratory tests probably because few parameters are experimentally controlled. It is difficult to carry out the test even by two persons. Measurement of the yield of cold smoke collected in a volume of 240 m^3 showed that for fuel controlled fires, reduced ventilation increased the smoke yield, while corridor length had no significant effect. For ventilation controlled fires, reducing the ventilation opening from 40 to 20 cm increased the smoke yield, but further reduction to 10 cm caused a decrease which is the result of the turbulent flame (Section 5.1.4.1) and the vigorous burning in the fire plume outside the test rig. The presence of the corridor increased D_O and with the corridor in place, D_O decreased with decreasing ventilation. The effect of corridor length on D_O proved to be random. This behaviour differs from that of the medium cribs which had a higher D_o as the ventilation decreased, and no significant effect for the length of the corridor. Regarding the small cribs, D_o increased as the ventilation was reduced, while the presence of the corridor had no significant effect.

The results were compared with D_o from EU and NBS tests. There was good agreement for cribs under full vent opening, but not for plastics. Even under free burning conditions, D_o for plastics was higher than D_o (plastics) in EU and NBS tests.

Dynamic measurements were carried out for experiments in which flame did not appear outside the corridor. The results showed higher static D_o than dynamic D_o (5 times or more greater).

Gas analysis showed the carbon monoxide increased with the reduction of the ventilation, although in all cases most of the carbon in the fuel was converted to CO_2 (75% to 90%). These two gases can produce a dangerous atmosphere, even from a fire of material classified "good" for smoke production in one of the laboratory tests.

6.1.5 <u>Variation of test conditions</u>

Laboratory tests for smoke production are used under standard conditions, which cannot represent the real fire. For this reason, variation in the conditions of the tests have been examined to find how sensitive the smoke production is to these changes.

6.1.5.1 EU test

(a) Thickness: With increasing the thickness, the D_s was increased proportionately. As most of the increase in the smoke yield was a result of more fuel being burnt, so standard optical density (D_o) is a better measure of smoke yield from a given material.

(b) The use of different layers and configurations of the same material or different materials: The results here show the complexity of the smoke production from materials under fire conditions. Although most of the combination tests showed that the smoke produced was additive, but some times gave more or less smoke according to the arrangement (e.g. combination of fibreboard and PMMA).

(c) Effect of stirring smoke inside the chamber: No effect on the maximum D_S was noticed, but this needs more comprehensive study, as in this test (EU) the light beam is vertical. Stirring would be necessary for a horizontal beam as stratification is expected.

(d) Radiation: Heat flux can have an important effect on the amount of smoke production. The tests show that with increasing the heat flux the smoke potential was increased as well. This is true for the four materials tested here in the range of 1 to 3 w/cm^2. The highest increase was found for wood (non-flaming) which gave 15 times more smoke at 3 w/cm^2 than at 1 w/cm^2 (see page 168).

6.1.5.2 Arapahoe chamber

It is very difficult to vary the conditions of test in the Arapahoe chamber. Few variations carried out, most of them seem to have no significant effect on smoke production, e.g. airflow time and rate. The most significant variation was observed with doubling the thickness of the sample. Under these conditions, more smoke was generated by non-flaming combustion after the 30 sec burning period.

6.1.6 General conclusion

Smoke is an inescapable hazard associated with fires, almost all fires produce smoke as soon as they begin. This led to the introduction of tests to assess the amount of smoke from combustible materials. Several countries have their own standard tests, but it is not clear that any of these tests are relevant to the "real" fire. Agreement between these tests is generally poor. In this project, the smoke yields in these tests have been studied and compared with each other and also with the small compartment fire test. The results show that while there is some agreement there are also big differences. These differences are mainly due to the different conditions of burning which result from differences between the test, e.g.

(a) Different sizes and shapes of the sample (except for NBS and EU tests) which can lead to different thermal characteristics, thus different smoke production.

(b) Different source and intensity of radiation which can lead to different rates of burning and thus different smoke production.

6.2 Recommendation for future work

6.2.1 Laboratory tests

(a) The EU test was built on the same principle as the NBS test to study the effect of larger volume. However, a different furnace was used and this led to uncertainty in the interpretation of results; the difference may be due to the chamber size or the type of furnace. It is recommended that the same furnace be used with different volumes of chamber (Appendix I) to investigate the effects of oxygen depletion and diluting the smoke.

(b) More investigations of the small scale laboratory tests should include a study of a heat radiation (level of heat flux) which can affect the rate of burning, thus the smoke production. Some uncertainty was apparent in the results of the molten materials as a result of the loss of part of the melted material. To overcome this, a horizontal sample holder could be used. Horizontal burning was studied by Breden *et al.* (1976) and Bankston *et al.* (1978) who found that more smoke is produced with this configuration. Further study is needed to find which is more relevant to the fire.

(c) It is worth considering measuring the smoke and the gas yields in the small scale laboratory tests.

(d) More tests for the same materials by different small scale laboratory tests should be carried out to relate these tests to each other.

6.2.2 *Fire compartment method*

(a) There is a need to have a more accessible test chamber with greater availability than that at the Scottish Fire Service Training School at Gullane. Extract facilities should be provided.

(b) More sensitive load cells should be used to weigh the sample only. This should allow better sealing of the box and corridor, thus more reliable gas concentration measurements.

(c) Different materials and composite materials should be tested in various configurations (e.g. wall lining).

(d) In dynamic measurements, most of the uncertainty was due to non-uniformity of smoke flow outside the corridor, either in depth, width or temperature. The use of a chimney at the end of the corridor may lead to uniformity in flow, temperature and concentration of hot gases, and also no stratification of smoke would be expected here. This uniform smoke can then be measured by a light beam shining across this chimney.

(e) As a big difference has been recorded between the static and dynamic D_o (cold and hot smoke), it is worth while trying to measure cold smoke by the dynamic method; this may be possible using the duct of the extract system in the Fire Safety Engineering Department (Edinburgh University).

On completion of this work, a limited number of full scale compartment fires can be designed to test the conclusions of the small scale experiments. These could be carried out using the full room-corridor assembly at the Fire Research Station.

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APPENDIX I

NBS Heater Test

APPENDIX I: NBS heater test.

The idea behind the EU test was to investigate the effect of a greater volume on the measured smoke yield when compared with the NBS test. The results differed, but as the furnace in the EU test differed from the NBS furnace, there was uncertainty about the source of the difference in the results. So a furnace was built in the Fire Engineering department according to the specification of the ASTME 662 (NBS furnace) and used in EU Chamber (13.75 m^3). Only a few tests were done with this furnace, as the heater which was bought from the USA operated on 110 volts, and was damaged on three occasions. It was found that there was a difference of ~20-25% in D_o for the same material when the heater was changed. The results are tabulated in Table I. These results show that D_o with the NBS heater is higher than in the EU test but lower in the NBS test (with the exception of fibreboard). This suggests that the higher smoke production found in the NBS test compared with the EU test could be due partly to the type of furnace. To check this it would be necessary to have the NBS and the EU tests in the same laboratory and use the NBS furnace in both tests.

TABLE I: NBS furnace with EU chamber (flaming).

Material	D (ob)	Weight loss (gm)	D_o (ob.m^3/gm)	D_s	t_m (min)	% Weight loss
Fibreboard	0.15	12.52	0.17 *(0.09, 0.03)**	49	9.0	74
White pine wood	0.52	23.15	0.31 *(0.2, 0.4)*	169	11.5	76
Heavy black foam	0.19	4.25	0.61 *(0.2, 1.2)*	62	5.0	18
Additive foam	0.16	1.02	2.61 *(1.4, 3.2)*	52	1.0	40

*The numbers in parenthesis represent D_o for the EU test and the NBS test, respectively.

APPENDIX II

Fire Compartment

Individual Results

TABLE 1: Small crib - free burning.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.03	000.000	00.000
01.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.04	000.000	00.000
01.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.00	0.04	000.000	00.000
02.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.01	0.04	000.000	00.000
02.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.01	0.04	000.000	00.000
03.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.02	0.01	0.04	000.000	00.000
03.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.02	0.02	0.05	000.000	00.000
04.00	000	000	000	00.00	0.02	0000	0000	0.00	0.00	00.00	00.000	00.00	0.04	0.03	0.06	000.000	00.000
04.30	000	000	000	00.00	0.04	0000	0000	0.00	0.00	00.00	00.000	00.00	0.06	0.05	0.07	000.000	00.000
05.00	000	000	000	00.00	0.05	0000	0000	0.00	0.00	00.00	00.000	00.00	0.07	0.07	0.08	000.000	00.000
05.30	000	000	000	00.00	0.07	0000	0000	0.00	0.00	00.00	00.000	00.00	0.09	0.10	0.09	000.000	00.000
06.00	000	000	000	00.00	0.10	0000	0000	0.00	0.00	00.00	00.000	00.00	0.13	0.13	0.13	000.000	00.000
06.30	000	000	000	00.00	0.12	0000	0000	0.00	0.00	00.00	00.000	00.00	0.15	0.17	0.15	000.000	00.000
07.00	000	000	000	00.00	0.14	0000	0000	0.00	0.00	00.00	00.000	00.00	0.16	0.20	0.15	000.000	00.000
07.30	000	000	000	00.00	0.16	0000	0000	0.00	0.00	00.00	00.000	00.00	0.22	0.22	0.20	000.000	00.000
08.00	000	000	000	00.00	0.19	0000	0000	0.00	0.00	00.00	00.000	00.00	0.22	0.27	0.22	000.000	00.000
08.30	000	000	000	00.00	0.22	0000	0000	0.00	0.00	00.00	00.000	00.00	0.23	0.29	0.27	000.000	00.000
09.00	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.24	0.32	000.000	00.000
09.30	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.29	0.22	0.31	000.000	00.000
10.00	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.29	0.24	0.31	000.000	00.000
10.30	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.31	0.29	0.32	000.000	00.000
11.00	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.31	0.31	000.000	00.000
11.30	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.29	0.31	000.000	00.000
12.00	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.29	0.27	0.31	000.000	00.000
12.30	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.27	0.33	000.000	00.000
13.00	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.29	0.25	0.32	000.000	00.000
13.30	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.32	000.000	00.000
14.00	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.27	0.32	000.000	00.000
14.30	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.23	0.27	0.32	000.000	00.000
15.00	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.27	0.32	000.000	00.000
15.30	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.30	000.000	00.000
16.00	000	000	000	00.00	0.24	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.30	000.000	00.000
16.30	000	000	000	00.00	0.23	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.29	000.000	00.000
17.00	000	000	000	00.00	0.23	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.29	000.000	00.000
17.30	000	000	000	00.00	0.22	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.29	000.000	00.000
18.00	000	000	000	00.00	0.22	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.25	0.29	000.000	00.000
18.30	000	000	000	00.00	0.21	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.25	0.29	000.000	00.000
19.00	000	000	000	00.00	0.20	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.25	0.23	000.000	00.000
19.30	000	000	000	00.00	0.20	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.25	0.23	000.000	00.000
20.00	000	000	000	00.00	0.23	0000	0000	0.00	0.00	00.00	00.000	00.00	0.29	0.24	0.23	000.000	00.000

TABLE 2: Small crib - box - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	020	020	002	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	21.63	0.00	0.00	0.00	000.000	00.000
00.30	020	020	046	00.00	0.00	0000	0000	0.10	0.00	00.17	00.000	21.57	0.00	0.00	0.01	000.000	00.000
01.00	020	020	078	00.00	0.00	0000	0000	0.12	0.00	00.37	00.000	20.75	0.00	0.00	0.01	000.000	00.000
01.30	020	020	118	00.00	0.00	0000	0000	0.15	0.00	00.79	00.000	20.62	0.00	0.00	0.01	000.000	00.000
02.00	020	020	190	00.00	0.00	0000	0000	0.22	0.00	00.40	00.000	19.93	0.00	0.00	0.02	000.000	00.000
02.30	020	020	239	00.00	0.00	0000	0000	0.27	0.00	00.47	00.128	19.86	0.01	0.01	0.02	000.000	00.000
03.00	020	020	295	00.00	0.00	0000	0000	0.36	0.00	00.96	00.112	18.93	0.01	0.02	0.02	000.000	00.000
03.30	020	020	415	00.00	0.01	0000	0000	0.53	0.00	01.58	00.121	18.75	0.01	0.02	0.02	000.000	00.000
04.00	020	020	594	00.00	0.01	0000	0000	0.58	0.00	02.36	00.174	18.86	0.02	0.04	0.03	000.000	00.000
04.30	020	020	603	00.00	0.03	0000	0000	1.15	0.00	03.26	00.356	17.56	0.03	0.06	0.04	000.000	00.000
05.00	020	020	582	00.00	0.05	0000	0000	1.43	0.00	04.13	00.313	16.94	0.05	0.07	0.06	000.000	00.000
05.30	021	021	660	00.00	0.07	0000	0000	1.82	0.00	04.53	01.219	16.37	0.07	0.09	0.08	000.000	00.000
06.00	021	021	643	00.00	0.12	0000	0000	2.26	0.00	05.43	01.071	15.43	0.11	0.13	0.12	000.000	00.000
06.30	021	021	554	00.00	0.17	0000	0000	2.24	0.00	06.59	01.936	15.22	0.20	0.17	0.20	000.000	00.000
07.00	021	021	548	00.00	0.20	0000	0000	2.19	0.00	07.16	00.151	14.34	0.22	0.20	0.22	000.000	00.000
07.30	021	021	594	00.00	0.23	0000	0000	2.07	0.00	07.10	00.147	13.49	0.27	0.18	0.27	000.000	00.000
08.00	021	021	375	00.00	0.28	0000	0000	1.70	0.00	06.73	00.153	12.36	0.27	0.23	0.31	000.000	00.000
08.30	021	021	279	00.00	0.31	0000	0000	1.41	0.00	05.34	00.152	12.91	0.24	0.27	0.33	000.000	00.000
09.00	021	021	203	00.00	0.32	0000	0000	1.19	0.00	04.10	00.152	13.43	0.32	0.27	0.37	000.000	00.000
09.30	021	022	159	00.00	0.33	0000	0000	1.05	0.00	02.98	00.190	14.55	0.29	0.26	0.37	000.000	00.000
10.00	021	022	145	00.00	0.31	0000	0000	0.95	0.00	02.08	00.233	15.57	0.27	0.25	0.36	000.000	00.000
10.30	021	022	126	00.00	0.31	0000	0000	0.84	0.00	01.79	00.216	16.54	0.29	0.22	0.33	000.000	00.000
11.00	021	022	121	00.00	0.31	0000	0000	0.73	0.00	01.64	00.232	17.37	0.29	0.21	0.32	000.000	00.000
11.30	021	022	105	00.00	0.29	0000	0000	0.66	0.00	01.45	00.197	17.62	0.29	0.22	0.32	000.000	00.000
12.00	021	022	095	00.00	0.27	0000	0000	0.60	0.00	01.29	00.179	18.44	0.23	0.29	0.33	000.000	00.000
12.30	021	022	090	00.00	0.29	0000	0000	0.54	0.00	01.09	00.183	18.42	0.23	0.29	0.32	000.000	00.000
13.00	021	022	086	00.00	0.27	0000	0000	0.50	0.00	00.94	00.175	18.53	0.23	0.29	0.32	000.000	00.000
13.30	021	022	083	00.00	0.30	0000	0000	0.46	0.00	00.85	00.157	18.58	0.29	0.21	0.32	000.000	00.000
14.00	021	022	076	00.00	0.30	0000	0000	0.43	0.00	00.75	00.163	18.64	0.23	0.19	0.32	000.000	00.000
14.30	021	022	071	00.00	0.30	0000	0000	0.37	0.00	00.70	00.162	18.66	0.27	0.20	0.31	000.000	00.000
15.00	021	023	066	00.00	0.30	0000	0000	0.35	0.00	00.63	00.158	18.67	0.29	0.17	0.31	000.000	00.000
15.30	021	023	065	00.00	0.30	0000	0000	0.32	0.00	00.57	00.155	18.69	0.23	0.19	0.32	000.000	00.000
16.00	021	023	063	00.00	0.30	0000	0000	0.23	0.00	00.59	00.155	18.79	0.28	0.18	0.32	000.000	00.000
16.30	021	023	064	00.00	0.30	0000	0000	0.25	0.00	00.45	00.146	19.77	0.22	0.18	0.32	000.000	00.000
17.00	021	023	057	00.00	0.30	0000	0000	0.23	0.00	00.44	00.149	18.86	0.23	0.18	0.31	000.000	00.000
17.30	021	023	057	00.00	0.30	0000	0000	0.21	0.00	00.44	00.143	19.27	0.29	0.18	0.31	000.000	00.000
18.00	021	022	064	00.00	0.27	0000	0000	0.20	0.00	00.44	00.173	18.71	0.27	0.18	0.32	000.000	00.000
18.30	021	023	049	00.00	0.27	0000	0000	0.19	0.00	00.44	00.148	18.79	0.23	0.18	0.33	000.000	00.000
19.00	021	023	045	00.00	0.27	0000	0000	0.18	0.00	00.42	00.137	18.73	0.23	0.18	0.32	000.000	00.000
19.30	021	022	050	00.00	0.27	0000	0000	0.17	0.00	00.41	00.135	18.75	0.27	0.18	0.31	000.000	00.000
20.00	021	022	055	00.00	0.27	0000	0000	0.17	0.00	00.44	00.142	18.97	0.23	0.18	0.31	000.000	00.000
20.30	021		047	00.00	0.27	0000	0000	0.16	0.00	00.43	00.129	18.99	0.27	0.17	0.32	000.000	00.000
21.00	021		044	00.00	0.27	0000	0000	0.14	0.00	00.42	00.117	19.03	0.27	0.17	0.31	000.000	00.000

TABLE 3: Small crib - box - 20 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	015	001	039	00.00	0.00	0000	0000	0.37	0.00	00.00	00.173	19.23	0.00	0.00	0.00	000.000	00.000
00.30	015	001	054	00.00	0.00	0000	0000	0.47	0.00	00.00	00.175	19.24	0.00	0.00	0.01	000.000	00.000
01.00	015	001	095	00.00	0.00	0000	0000	0.33	0.00	00.13	00.132	19.75	0.00	0.00	0.01	000.000	00.000
01.30	015	001	096	00.00	0.00	0000	0000	0.29	0.00	00.15	00.132	18.73	0.00	0.00	0.01	000.000	00.000
02.00	015	001	145	00.00	0.00	0000	0000	0.13	0.00	00.36	00.097	18.34	0.00	0.00	0.02	000.000	00.000
02.30	015	001	195	00.00	0.00	0000	0000	0.16	0.00	00.32	00.095	18.34	0.00	0.00	0.02	000.000	00.000
03.00	015	001	276	00.00	0.00	0000	0000	0.25	0.00	01.17	00.111	16.63	0.00	0.00	0.02	000.000	00.000
03.30	015	002	313	00.00	0.00	0000	0000	0.33	0.00	01.55	00.124	17.30	0.00	0.00	0.02	000.000	00.000
04.00	015	002	358	00.00	0.00	0000	0000	0.43	0.00	02.33	00.132	17.13	0.01	0.01	0.03	000.000	00.000
04.30	015	002	443	00.00	0.01	0000	0000	0.72	0.00	02.43	00.129	16.73	0.02	0.01	0.03	000.000	00.000
05.00	015	002	587	00.00	0.03	0000	0000	1.13	0.00	03.17	00.134	16.37	0.03	0.03	0.04	000.000	00.000
05.30	015	002	667	00.00	0.05	0000	0000	1.73	0.00	04.39	00.147	15.12	0.08	0.05	0.07	000.000	00.000
06.00	015	002	749	00.00	0.08	0000	0000	2.27	0.00	05.76	00.333	13.30	0.13	0.09	0.10	000.000	00.000
06.30	015	002	804	00.00	0.12	0000	0000	3.32	0.00	07.02	03.114	12.76	0.22	0.17	0.15	000.000	00.000
07.00	015	002	823	00.00	0.29	0000	0000	3.27	0.00	09.16	03.749	11.53	0.35	0.22	0.23	000.000	00.000
07.30	015	002	749	00.00	0.40	0000	0000	3.23	0.00	07.01	01.301	10.76	0.40	0.42	0.33	000.000	00.000
08.00	015	002	644	00.00	0.51	0000	0000	2.72	0.00	04.34	00.339	12.36	0.53	0.43	0.53	000.000	00.000
08.30	015	002	374	00.00	0.57	0000	0000	1.67	0.00	02.73	00.141	14.51	0.70	0.59	0.54	000.000	00.000
09.00	015	002	274	00.00	0.55	0000	0000	1.31	0.00	00.33	00.144	16.87	0.71	0.60	0.59	000.000	00.000
09.30	015	003	225	00.00	0.53	0000	0000	1.13	0.00	00.39	00.133	17.61	0.61	0.53	0.57	000.000	00.000
10.00	015	003	254	00.00	0.57	0000	0000	1.01	0.00	00.23	00.239	17.77	0.56	0.57	0.57	000.000	00.000
10.30	015	003	233	00.00	0.55	0000	0000	0.34	0.00	00.13	00.243	17.81	0.53	0.55	0.55	000.000	00.000
11.00	015	003	234	00.00	0.55	0000	0000	0.77	0.00	00.17	00.271	17.34	0.54	0.56	0.53	000.000	00.000
11.30	015	003	232	00.00	0.53	0000	0000	0.73	0.00	00.00	00.231	18.38	0.53	0.57	0.61	000.000	00.000
12.00	015	003	211	00.00	0.53	0000	0000	0.64	0.00	00.00	00.256	18.33	0.46	0.54	0.59	000.000	00.000
12.30	015	003	193	00.00	0.55	0000	0000	0.54	0.00	00.00	00.244	18.17	0.46	0.54	0.55	000.000	00.000
13.00	015	003	182	00.00	0.53	0000	0000	0.46	0.00	00.00	00.22	18.41	0.45	0.52	0.55	000.000	00.000
13.30	015	003	167	00.00	0.53	0000	0000	0.44	0.00	00.00	00.233	[illegible]	0.44	0.53	0.51	000.000	00.000
14.00	015	003	165	00.00	0.52	0000	0000	0.36	0.00	00.00	00.212	18.35	0.43	0.52	0.51	000.000	00.000
14.30	015	003	151	00.00	0.52	0000	0000	0.34	0.00	00.00	00.216	18.33	0.44	0.52	0.49	000.000	00.000
15.00	015	003	146	00.00	0.52	0000	0000	0.33	0.00	00.00	00.233	18.75	0.45	0.51	0.43	000.000	00.000
15.30	015	003	127	00.00	0.51	0000	0000	0.33	0.00	00.00	00.213	18.73	0.44	0.51	0.46	000.000	00.000
16.00	015	003	126	00.00	0.50	0000	0000	0.33	0.00	00.00	00.247	18.81	0.45	0.43	0.49	000.000	00.000
16.30	015	003	120	00.00	0.51	0000	0000	0.31	0.00	00.00	00.251	18.83	0.46	0.50	0.43	000.000	00.000
17.00	015	003	115	00.00	0.50	0000	0000	0.19	0.00	00.00	00.221	19.34	0.46	0.49	0.48	000.000	00.000
17.30	015	003	107	00.00	0.49	0000	0000	0.18	0.00	00.00	00.179	19.34	0.46	0.47	0.47	000.000	00.000
18.00	015	002	108	00.00	0.43	0000	0000	0.17	0.00	00.00	00.150	18.38	0.45	0.45	0.47	000.000	00.000
18.30	015	003	102	00.00	0.43	0000	0000	0.15	0.00	00.00	00.149	18.33	0.46	0.46	0.47	000.000	00.000
19.00	015	003	099	00.00	0.47	0000	0000	0.14	0.00	00.00	00.149	18.70	0.46	0.45	0.47	000.000	00.000
19.30	015	002	091	00.00	0.47	0000	0000	0.14	0.00	00.00	00.142	18.70	0.45	0.45	0.46	000.000	00.000
20.00	015	003	085	00.00	0.46	0000	0000	0.13	0.00	00.00	00.136	18.72	0.45	0.44	0.46	000.000	00.000

TABLE 4: Small crib - box - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	017	000	007	00.00	0.00	0000	0000	0.39	0.00	00.00	00.103	21.11	0.00	0.00	0.00	000.000	00.000
00.30	017	000	045	00.00	0.00	0000	0000	0.10	0.00	00.07	00.114	20.33	0.00	0.00	0.03	000.000	00.000
01.00	017	000	074	00.00	0.00	0000	0000	0.11	0.00	00.43	00.112	20.47	0.00	0.00	0.03	000.000	00.000
01.30	017	000	117	00.00	0.00	0000	0000	0.13	0.00	00.73	00.117	20.11	0.00	0.00	0.03	000.000	00.000
02.00	017	000	167	00.00	0.00	0000	0000	0.15	0.00	01.13	00.117	19.74	0.00	0.00	0.03	000.000	00.000
02.30	017	001	237	00.00	0.00	0000	0000	0.21	0.00	01.71	00.131	19.24	0.00	0.00	0.02	000.000	00.000
03.00	017	000	330	00.00	0.00	0000	0000	0.32	0.00	02.33	00.129	18.49	0.00	0.00	0.02	000.000	00.000
03.30	017	000	432	00.00	0.01	0000	0000	0.56	0.00	03.33	00.121	17.53	0.00	0.00	0.02	000.000	00.000
04.00	017	000	637	00.00	0.01	0000	0000	0.73	0.00	05.47	00.143	15.36	0.01	0.00	0.03	000.000	00.000
04.30	017	000	823	00.00	0.04	0000	0000	2.16	0.00	09.73	00.135	12.43	0.06	0.00	0.08	000.000	00.000
05.00	017	000	857	00.00	0.11	0000	0000	3.77	0.00	13.43	[illegible]	07.34	0.13	0.09	0.13	000.000	00.000
05.30	017	000	836	00.00	0.23	0000	0000	4.16	0.00	16.19	[illegible]	04.34	0.24	0.19	0.26	000.000	00.000
06.00	017	001	821	00.00	0.67	0000	0000	1.77	0.00	17.26	04.105	01.37	0.71	0.52	0.31	000.000	00.000
06.30	017	001	832	00.00	1.31	0000	0000	0.30	0.00	17.23	03.319	01.16	1.59	1.02	1.14	000.000	00.000
07.00	017	001	817	00.00	1.46	0000	0000	1.73	0.00	17.42	01.523	01.53	1.37	1.41	1.51	000.000	00.000
07.30	017	001	746	00.00	1.43	0000	0000	4.37	0.00	11.35	00.155	07.49	1.73	1.23	1.65	000.000	00.000
08.00	017	001	559	00.00	1.36	0000	0000	3.10	0.00	06.30	00.137	12.91	1.67	1.37	1.69	000.000	00.000
08.30	017	001	455	00.00	1.47	0000	0000	2.36	0.00	03.56	[illegible]	16.50	1.53	1.52	1.53	000.000	00.000
09.00	017	001	413	00.00	1.51	0000	0000	1.72	0.00	02.21	[illegible]	18.41	1.54	1.41	1.50	000.000	00.000
09.30	017	001	392	00.00	1.36	0000	0000	1.50	0.00	01.34	00.243	18.39	1.48	1.49	1.53	000.000	00.000
10.00	017	001	368	00.00	1.37	0000	0000	1.52	0.00	01.70	00.235	18.35	1.45	1.43	1.49	000.000	00.000
10.30	017	001	334	00.00	1.34	0000	0000	1.33	0.00	01.76	00.232	19.01	1.34	1.37	1.51	000.000	00.000
11.00	018	001	316	00.00	1.41	0000	0000	1.15	0.00	01.42	00.232	19.23	1.31	1.36	1.49	000.000	00.000
11.30	019	001	392	00.00	1.45	0000	0000	0.95	0.00	01.21	00.215	19.55	1.31	1.29	1.51	000.000	00.000
12.00	019	001	285	00.00	1.42	0000	0000	0.85	0.00	00.37	00.159	19.70	1.33	1.37	1.48	000.000	00.000
12.30	017	001	298	00.00	1.40	0000	0000	0.74	0.00	00.35	00.194	19.91	1.29	1.34	1.51	000.000	00.000
13.00	018	001	270	00.00	1.33	0000	0000	0.66	0.00	00.72	00.175	20.45	1.23	1.34	1.48	000.000	00.000
13.30	019	001	255	00.00	1.34	0000	0000	0.59	0.00	00.65	00.171	20.13	1.30	1.22	1.45	000.000	00.000
14.00	019	001	[illegible]	00.00	1.33	0000	0000	0.54	0.00	[illegible]	00.167	20.17	1.32	1.31	1.36	000.000	00.000
14.30	019	001	[illegible]	00.00	1.32	0000	0000	0.47	0.00	00.53	00.167	20.17	1.16	1.23	1.36	000.000	00.000
15.00	019	001	207	00.00	1.22	0000	0000	0.42	0.00	00.43	00.162	20.25	1.33	1.29	1.30	000.000	00.000
15.30	018	001	197	00.00	1.25	0000	0000	0.33	0.00	00.14	00.153	20.27	1.33	1.19	1.37	000.000	00.000
16.00	018	001	179	00.00	1.22	0000	0000	0.34	0.00	[illegible]	00.154	20.35	[illegible]	1.15	1.33	000.000	00.000
16.30	017	001	178	00.00	1.20	0000	0000	0.31	0.00	[illegible]	00.154	20.40	1.27	1.11	1.30	000.000	00.000
17.00	017	001	166	00.00	1.19	0000	0000	0.29	0.00	00.23	00.147	20.43	1.26	1.11	1.30	000.000	00.000
17.30	017	001	164	00.00	1.17	0000	0000	0.27	0.00	[illegible]	00.144	20.47	1.24	1.07	1.29	000.000	00.000
18.00	017	001	155	00.00	1.16	0000	0000	0.25	0.00	00.23	00.173	20.53	[illegible]	1.11	1.28	000.000	00.000
18.30	017	001	147	00.00	1.15	0000	0000	0.23	0.00	00.17	00.136	20.54	1.25	1.04	1.25	000.000	00.000
19.00	017	001	138	00.00	1.14	0000	0000	0.22	0.00	00.15	00.134	20.57	1.26	1.03	1.25	000.000	00.000
19.30	017	001	135	00.00	1.13	0000	0000	0.22	0.00	00.14	00.133	20.58	1.21	1.03	1.24	000.000	00.000
20.00	017	001	130	00.00	1.12	0000	0000	0.20	0.00	00.11	00.137	20.61	1.23	1.02	1.25	000.000	00.000

TABLE 5: Small crib - 1 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	000	012	00.00	0.00	0000	0000	0.07	0.00	00.00	00.000	19.92	0.00	0.00	0.00	000.000	00.000
00.30	009	009	032	00.24	0.00	0000	0000	0.07	0.00	00.00	00.000	19.92	0.00	0.00	0.00	000.000	00.000
01.00	009	021	059	00.37	0.00	0000	0000	0.08	0.00	00.25	00.000	19.66	0.00	0.00	0.00	000.000	00.000
01.30	009	037	106	00.37	0.00	0000	0000	0.08	0.00	00.55	00.000	19.43	0.00	0.00	0.00	000.000	00.000
02.00	009	077	179	00.49	0.00	0000	0000	0.10	0.00	01.12	00.000	19.11	0.00	0.00	0.00	000.000	00.000
02.30	009	120	275	00.57	0.00	0000	0000	0.13	0.00	01.34	00.000	18.55	0.01	0.01	0.00	000.000	00.000
03.00	009	155	363	00.61	0.00	0000	0000	0.15	0.00	02.71	00.000	17.37	0.00	0.01	0.01	000.000	00.000
03.30	009	199	444	00.70	0.00	0000	0000	0.21	0.00	03.59	00.005	17.11	0.04	0.01	0.04	000.000	00.000
04.00	010	214	500	00.79	0.00	0000	0000	0.31	0.00	04.03	00.000	16.54	0.06	0.06	0.06	000.000	00.000
04.30	010	242	575	00.81	0.00	0000	0000	0.40	0.00	04.37	00.003	16.12	0.10	0.08	0.10	000.000	00.000
05.00	010	261	652	00.34	0.00	0000	0000	0.51	0.00	04.73	00.009	15.77	0.15	0.11	0.14	000.000	00.000
05.30	010	280	659	00.39	0.00	0000	0000	0.63	0.00	05.23	00.005	15.32	0.22	0.18	0.21	000.000	00.000
06.00	010	273	632	00.33	0.00	0000	0000	0.55	0.00	05.11	00.001	15.34	0.24	0.25	0.25	000.000	00.000
06.30	010	256	558	00.35	0.00	0000	0000	0.53	0.00	04.84	00.005	15.21	0.23	0.31	0.31	000.000	00.000
07.00	010	251	491	00.38	0.00	0000	0000	0.43	0.00	04.07	00.100	15.34	0.33	0.33	0.37	000.000	00.000
07.30	010	222	405	00.39	0.00	0000	0000	0.34	0.00	03.05	00.103	16.55	0.39	0.42	0.46	000.000	00.000
08.00	010	196	333	00.35	0.00	0000	0000	0.27	0.00	02.07	00.112	17.44	0.32	0.44	0.44	000.000	00.000
08.30	010	158	293	00.33	0.00	0000	0000	0.23	0.00	01.31	00.124	19.19	0.37	0.46	0.41	000.000	00.000
09.00	010	144	276	00.73	0.00	0000	0000	0.22	0.00	01.12	00.138	19.56	0.29	0.47	0.40	000.000	00.000
09.30	010	132	273	00.75	0.00	0000	0000	0.20	0.00	01.00	00.164	18.36	0.31	0.47	0.42	000.000	00.000
10.00	010	124	277	00.76	0.00	0000	0000	0.17	0.00	00.83	00.159	19.77	0.31	0.48	0.41	000.000	00.000
10.30	010	118	258	00.66	0.00	0000	0000	0.17	0.00	00.74	00.152	18.33	0.33	0.47	0.40	000.000	00.000
11.00	010	113	254	00.69	0.00	0000	0000	0.16	0.00	00.56	00.141	19.02	0.32	0.46	0.42	000.000	00.000
11.30	010	107	240	00.67	0.00	0000	0000	0.16	0.00	00.48	00.137	19.13	0.27	0.47	0.38	000.000	00.000
12.00	010	102	227	00.67	0.00	0000	0000	0.14	0.00	00.38	00.133	19.17	0.25	0.46	0.37	000.000	00.000
12.30	010	099	211	00.65	0.00	0000	0000	0.14	0.00	00.27	00.125	19.25	0.24	0.46	0.33	000.000	00.000
13.00	010	093	200	00.62	0.00	0000	0000	0.13	0.00	00.23	00.119	19.33	0.24	0.47	0.33	000.000	00.000
13.30	010	088	190	00.62	0.00	0000	0000	0.12	0.00	00.12	00.110	19.33	0.25	0.46	0.33	000.000	00.000
14.00	010	083	180	00.61	0.00	0000	0000	0.12	0.00	00.09	00.107	19.45	0.27	0.44	0.33	000.000	00.000
14.30	010	080	173	00.59	0.00	0000	0000	0.12	0.00	00.01	00.102	19.49	0.24	0.43	0.33	000.000	00.000
15.00	010	077	164	00.61	0.00	0000	0000	0.12	0.00	00.00	00.099	19.53	0.24	0.44	0.38	000.000	00.000
15.30	010	072	157	00.59	0.00	0000	0000	0.12	0.00	00.00	00.096	19.57	0.25	0.43	0.37	000.000	00.000
16.00	010	070	150	00.57	0.00	0000	0000	0.12	0.00	00.00	00.094	19.61	0.24	0.42	0.39	000.000	00.000
16.30	010	067	143	00.58	0.00	0000	0000	0.11	0.00	00.00	00.092	19.65	0.23	0.42	0.37	000.000	00.000
17.00	010	065	138	00.57	0.00	0000	0000	0.11	0.00	00.00	00.092	19.67	0.22	0.42	0.39	000.000	00.000
17.30	010	062	132	00.54	0.00	0000	0000	0.10	0.00	00.00	00.089	19.69	0.24	0.41	0.38	000.000	00.000
18.00	010	060	127	00.55	0.00	0000	0000	0.11	0.00	00.00	00.086	19.71	0.24	0.42	0.33	000.000	00.000
18.30	010	058	124	00.51	0.00	0000	0000	0.11	0.00	00.00	00.083	19.73	0.23	0.41	0.37	000.000	00.000
19.00	010	057	120	00.53	0.00	0000	0000	0.10	0.00	00.00	00.084	19.73	0.22	0.41	0.37	000.000	00.000
19.30	010	054	117	00.52	0.00	0000	0000	0.10	0.00	00.00	00.083	19.74	0.23	0.41	0.37	000.000	00.000
20.00	010	053	113	00.51	0.00	0000	0000	0.08	0.00	00.00	00.081	17.74	0.22	0.40	0.37	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	018	034	00.33	0.00	0000	0000	0.08	0.00	00.00	00.000	20.94	0.00	0.00	0.00	000.000	00.000
00.30	009	037	050	00.42	0.00	0000	0000	0.09	0.00	00.00	00.000	20.95	0.00	0.00	0.00	000.000	00.000
01.00	009	066	073	00.52	0.00	0000	0000	0.09	0.00	00.49	00.000	20.47	0.00	0.00	0.00	000.000	00.000
01.30	009	099	116	00.55	0.00	0000	0000	0.10	0.00	00.38	00.000	20.45	0.00	0.00	0.00	000.000	00.000
02.00	009	139	167	00.58	0.00	0000	0000	0.11	0.00	01.77	00.000	19.52	0.01	0.00	0.00	000.000	00.000
02.30	008	189	308	00.63	0.00	0000	0000	0.15	0.00	02.65	00.000	18.77	0.01	0.00	0.01	000.000	00.000
03.00	009	279	423	00.72	0.00	0000	0000	0.21	0.00	03.37	00.157	17.77	0.02	0.00	0.02	000.000	00.000
03.30	009	324	519	00.85	0.00	0000	0000	0.33	0.00	04.94	00.167	16.50	0.04	0.03	0.05	000.000	00.000
04.00	009	373	618	00.71	0.00	0000	0000	0.54	0.00	05.90	00.172	15.46	0.08	0.07	0.10	000.000	00.000
04.30	010	378	658	00.87	0.00	0000	0000	0.75	0.00	06.84	00.183	14.23	0.14	0.12	0.19	000.000	00.000
05.00	010	400	671	00.97	0.00	0000	0000	1.20	0.00	07.27	00.193	13.52	0.22	0.22	0.32	000.000	00.000
05.30	010	364	617	00.93	0.00	0000	0000	0.89	0.00	07.13	00.201	13.24	0.31	0.34	0.40	000.000	00.000
06.00	010	331	531	00.87	0.00	0000	0000	0.57	0.00	06.20	00.183	13.76	0.35	0.43	0.44	000.000	00.000
06.30	010	324	441	00.89	0.00	0000	0000	0.41	0.00	04.62	00.173	15.42	0.38	0.45	0.48	000.000	00.000
07.00	010	197	332	00.70	0.00	0000	0000	0.34	0.00	03.19	00.182	16.87	0.38	0.46	0.45	000.000	00.000
07.30	010	159	263	00.88	0.00	0000	0000	0.33	0.00	02.85	00.227	18.19	0.33	0.47	0.45	000.000	00.000
08.00	010	144	198	00.85	0.00	0000	0000	0.27	0.00	01.69	00.235	18.96	0.32	0.45	0.47	000.000	00.000
08.30	010	134	189	00.82	0.00	0000	0000	0.26	0.00	01.48	00.245	19.23	0.31	0.50	0.46	000.000	00.000
09.00	010	127	182	00.73	0.00	0000	0000	0.22	0.00	01.44	00.259	19.33	0.29	0.47	0.45	000.000	00.000
09.30	010	129	177	00.79	0.00	0000	0000	0.21	0.00	01.31	00.251	19.40	0.27	0.46	0.42	000.000	00.000
10.00	009	110	179	00.76	0.00	0000	0000	0.21	0.00	01.16	00.242	19.53	0.26	0.46	0.40	000.000	00.000
10.30	009	105	172	00.73	0.00	0000	0000	0.23	0.00	00.99	00.222	19.73	0.27	0.45	0.41	000.000	00.000
11.00	009	101	164	00.75	0.00	0000	0000	0.18	0.00	00.94	00.222	19.82	0.26	0.43	0.39	000.000	00.000
11.30	009	096	157	00.66	0.00	0000	0000	0.17	0.00	00.91	00.214	19.89	0.24	0.44	0.37	000.000	00.000
12.00	009	092	149	00.66	0.00	0000	0000	0.16	0.00	00.71	00.211	19.96	0.25	0.44	0.39	000.000	00.000
12.30	009	089	143	00.64	0.00	0000	0000	0.15	0.00	00.61	00.204	20.19	0.23	0.44	0.40	000.000	00.000
13.00	009	087	137	00.66	0.00	0000	0000	0.16	0.00	00.53	00.194	20.16	0.23	0.43	0.39	000.000	00.000
13.30	009	084	131	00.60	0.00	0000	0000	0.16	0.00	00.44	00.184	20.24	0.26	0.42	0.39	000.000	00.000
14.00	009	081	124	00.61	0.00	0000	0000	0.14	0.00	00.37	00.180	20.29	0.27	0.44	0.40	000.000	00.000
14.30	009	079	118	00.57	0.00	0000	0000	0.14	0.00	00.32	00.175	20.34	0.27	0.43	0.40	000.000	00.000
15.00	009	076	112	00.54	0.00	0000	0000	0.14	0.00	00.23	00.166	20.40	0.27	0.45	0.39	000.000	00.000
15.30	009	072	107	00.52	0.00	0000	0000	0.14	0.00	00.22	00.162	20.44	0.25	0.43	0.33	000.000	00.000
16.00	009	071	104	00.53	0.00	0000	0000	0.13	0.00	00.19	00.155	20.49	0.25	0.43	0.37	000.000	00.000
16.30	009	068	099	00.53	0.00	0000	0000	0.12	0.00	00.17	00.159	20.51	0.26	0.43	0.33	000.000	00.000
17.00	009	066	097	00.52	0.00	0000	0000	0.12	0.00	00.16	00.159	20.52	0.24	0.44	0.38	000.000	00.000
17.30	009	064	095	00.54	0.00	0000	0000	0.13	0.00	00.14	00.158	20.54	0.24	0.44	0.33	000.000	00.000
18.00	009	063	093	00.53	0.00	0000	0000	0.12	0.00	00.14	00.157	20.55	0.24	0.42	0.38	000.000	00.000
18.30	009	061	090	00.53	0.00	0000	0000	0.12	0.00	00.13	00.158	20.55	0.23	0.43	0.38	000.000	00.000
19.00	009	059	088	00.52	0.00	0000	0000	0.11	0.00	00.12	00.155	20.55	0.23	0.42	0.37	000.000	00.000
19.30	009	057	088	00.50	0.00	0000	0000	0.12	0.00	00.13	00.156	20.56	0.26	0.42	0.37	000.000	00.000
20.00	009	056	087	00.50	0.00	0000	0000	0.11	0.00	00.12	00.154	20.56	0.22	0.42	0.37	000.000	00.000

TABLE 5: Small crib - 1 m corridor - 40 cm opening (cont.).

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	025	034	00.30	00.0	0000	0000	0.03	0.00	00.00	00.000	19.93	0.00	0.00	0.00	000.000	00.000
00.30	009	036	055	00.43	00.2	0000	0000	0.04	0.00	00.00	00.000	19.96	0.00	0.01	0.00	000.000	00.000
01.00	009	049	075	00.51	00.3	0000	0000	0.04	0.00	00.47	00.000	18.93	0.00	0.00	0.00	000.000	00.000
01.30	009	067	105	00.57	00.1	0000	0000	0.05	0.00	00.95	00.000	18.73	0.00	0.00	0.00	000.000	00.000
02.00	009	088	144	00.64	00.0	0000	0000	0.13	0.00	01.58	00.000	18.46	0.00	0.00	0.00	000.000	00.000
02.30	009	110	228	00.66	00.0	0000	0000	0.14	0.00	02.36	00.075	17.56	0.00	0.00	0.00	000.000	00.000
03.00	009	131	324	00.90	00.3	0001	0000	0.19	0.00	03.26	00.078	16.74	0.00	0.00	0.00	000.000	00.000
03.30	009	148	379	00.96	01.4	0003	0000	0.33	0.00	04.13	00.088	16.37	0.00	0.00	0.00	000.000	00.000
04.00	009	167	488	00.90	01.7	0004	0001	0.52	0.00	04.53	00.092	15.43	0.00	0.00	0.00	000.000	00.000
04.30	009	225	571	00.71	03.8	0010	0006	0.73	0.00	05.43	00.095	15.22	0.00	0.00	0.00	000.000	00.000
05.00	009	274	621	01.00	03.4	0010	0011	0.75	0.00	06.59	00.101	14.34	0.00	0.00	0.00	000.000	00.000
05.30	009	292	605	00.79	06.1	0018	0019	0.45	0.00	07.16	00.108	13.49	0.00	0.00	0.00	000.000	00.000
06.00	009	281	591	00.97	04.2	0011	0025	0.45	0.00	07.10	00.109	12.36	0.00	0.00	0.00	000.000	00.000
06.30	009	265	509	00.73	04.7	0013	0031	0.39	0.00	06.73	00.116	12.91	0.00	0.00	0.00	000.000	00.000
07.00	009	242	416	00.87	02.2	0005	0036	0.31	0.00	05.34	00.115	13.43	0.00	0.00	0.00	000.000	00.000
07.30	009	161	346	00.94	01.0	0002	0036	0.23	0.00	04.10	00.124	14.55	0.00	0.00	0.00	000.000	00.000
08.00	009	136	264	00.34	00.4	0001	0036	0.17	0.00	02.79	00.141	15.57	0.00	0.00	0.00	000.000	00.000
08.30	009	121	232	00.32	00.3	0001	0036	0.15	0.00	02.08	00.154	16.54	0.00	0.00	0.00	000.000	00.000
09.00	009	114	164	00.81	00.0	0000	0036	0.14	0.00	01.79	00.139	17.37	0.00	0.00	0.00	000.000	00.000
09.30	009	108	155	00.76	00.0	0000	0036	0.13	0.00	01.64	00.126	17.62	0.00	0.00	0.00	000.000	00.000
10.00	009	103	151	00.83	00.0	0000	0036	0.12	0.00	01.43	00.135	17.79	0.00	0.00	0.00	000.000	00.000
10.30	009	099	141	00.83	00.0	0000	0036	0.11	0.00	01.31	00.122	17.79	0.00	0.00	0.00	000.000	00.000
11.00	009	095	139	00.82	00.0	0000	0036	0.11	0.00	01.22	00.185	17.94	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	012	022	025	00.30	00.0	0000	0000	0.05	0.00	00.00	00.000	20.40	0.00	0.00	0.00	000.000	00.000
00.30	011	044	039	00.27	00.0	0000	0000	0.05	0.00	00.00	00.000	20.40	0.00	0.00	0.00	000.000	00.000
01.00	011	062	057	00.41	00.0	0000	0000	0.05	0.00	00.31	00.000	20.25	0.00	0.00	0.00	000.000	00.000
01.30	011	099	077	00.50	00.0	0000	0000	0.07	0.00	00.63	00.000	19.92	0.00	0.00	0.00	000.000	00.000
02.00	011	125	109	00.52	00.2	0000	0000	0.08	0.00	01.11	00.000	19.56	0.00	0.00	0.00	000.000	00.000
02.30	011	179	166	00.64	00.2	0000	0000	0.11	0.00	01.75	00.000	19.23	0.00	0.00	0.00	000.000	00.000
03.00	011	233	275	00.69	00.4	0001	0000	0.15	0.00	02.59	00.000	18.76	0.00	0.00	0.00	000.000	00.000
03.30	011	289	323	00.82	00.3	0001	0000	0.29	0.00	03.50	00.000	17.72	0.00	0.00	0.00	000.000	00.000
04.00	011	326	385	01.03	01.0	0003	0000	0.25	0.00	04.03	00.115	17.12	0.00	0.00	0.00	000.000	00.000
04.30	011	372	463	01.11	00.7	0003	0000	0.36	0.00	04.36	00.114	16.62	0.00	0.00	0.00	000.000	00.000
05.00	011	409	535	01.07	02.3	0011	0004	0.50	0.00	05.25	00.116	16.14	0.00	0.00	0.00	000.000	00.000
05.30	011	427	590	00.99	01.3	0005	0008	0.53	0.00	06.02	00.122	15.52	0.00	0.00	0.00	000.000	00.000
06.00	011	417	541	00.99	00.8	0003	0009	0.55	0.00	06.51	00.123	14.57	0.00	0.00	0.00	000.000	00.000
06.30	011	429	553	01.19	01.7	0009	0013	0.57	0.00	05.36	00.121	14.66	0.00	0.00	0.00	000.000	00.000
07.00	011	411	551	00.95	01.7	0007	0019	0.58	0.00	05.37	00.127	14.76	0.00	0.00	0.00	000.000	00.000
07.30	011	388	593	01.05	02.4	0009	0025	0.53	0.00	05.62	00.133	15.29	0.00	0.00	0.00	000.000	00.000
08.00	011	330	402	00.77	00.8	0003	0027	0.41	0.00	05.10	00.136	15.27	0.00	0.00	0.00	000.000	00.000
08.30	011	263	328	00.87	01.1	0003	0029	0.31	0.00	03.78	00.146	16.02	0.00	0.00	0.00	000.000	00.000
09.00	011	171	255	00.71	00.6	0001	0023	0.25	0.00	02.64	00.153	16.74	0.00	0.00	0.00	000.000	00.000
09.30	011	159	186	00.94	00.6	0001	0028	0.22	0.00	01.77	00.177	18.13	0.00	0.00	0.00	000.000	00.000
10.00	011	141	179	00.34	00.5	0001	0023	0.21	0.00	01.61	00.187	18.53	0.00	0.00	0.00	000.000	00.000
10.30	011	132	165	00.36	00.9	0002	0029	0.19	0.00	01.46	00.195	19.36	0.00	0.00	0.00	000.000	00.000
11.00	011	128	154	00.31	00.7	0001	0029	0.18	0.00	01.25	00.197	19.40	0.00	0.00	0.00	000.000	00.000
11.30	011	121	153	00.77	00.8	0001	0028	0.16	0.00	01.24	00.196	19.32	0.00	0.00	0.00	000.000	00.000
12.00	011	119	144	00.73	00.9	0001	0029	0.15	0.00	01.19	00.188	19.30	0.00	0.00	0.00	000.000	00.000
12.30	011	109	153	00.67	00.7	0001	0029	0.15	0.00	01.04	00.188	19.52	0.00	0.00	0.00	000.000	00.000
13.00	011	105	151	00.72	00.7	0001	0028	0.14	0.00	00.86	00.171	19.53	0.00	0.00	0.00	000.000	00.000

TABLE 6: Small crib - 1 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	019	021	005	00.00	0.00	0000	0000	0.00	0.00	00.00	00.062	16.77	0.00	0.00	0.00	000.000	00.000
00.30	012	034	075	00.15	0.00	0000	0000	0.05	0.00	00.00	00.063	16.78	0.00	0.00	0.03	000.000	00.000
01.00	016	051	103	00.33	0.00	0000	0000	0.10	0.00	00.40	00.091	16.75	0.00	0.00	0.03	000.000	00.000
01.30	016	067	141	00.41	0.00	0000	0000	0.10	0.00	00.24	00.079	[illegible]	0.00	0.00	0.03	000.000	00.000
02.00	017	108	222	00.42	0.00	0000	0000	0.10	0.00	01.27	00.076	16.03	0.00	0.00	0.03	000.000	00.000
02.30	017	164	347	00.51	0.01	0000	0000	0.12	0.00	01.79	00.088	15.57	0.01	0.00	0.03	000.000	00.000
03.00	018	207	485	00.58	0.02	0000	0000	0.20	0.00	02.77	00.106	15.05	0.01	0.01	0.03	000.000	00.000
03.30	018	277	613	00.51	0.03	0000	0000	0.41	0.00	04.03	00.094	14.45	0.02	0.01	0.05	000.000	00.000
04.00	018	314	674	00.51	0.06	0000	0000	0.60	0.00	05.32	00.182	13.63	0.05	0.03	0.05	000.000	00.000
04.30	019	331	755	00.51	0.14	0000	0000	0.63	0.00	07.13	01.208	12.54	0.05	0.25	0.12	000.000	00.000
05.00	019	338	821	00.54	0.47	0000	0000	0.57	0.00	07.40	01.071	[illegible]	0.24	0.15	0.26	000.000	00.000
05.30	018	335	863	00.53	0.35	0000	0000	0.85	0.00	07.27	00.506	[illegible]	0.74	0.73	0.71	000.000	00.000
06.00	016	332	877	00.51	1.31	0000	0000	0.84	0.00	06.77	00.111	12.17	1.03	0.74	1.16	000.000	00.000
06.30	019	320	782	00.54	1.30	0000	0000	0.79	0.00	06.25	00.121	12.81	1.22	1.18	1.31	000.000	00.000
07.00	019	274	573	00.53	1.21	0000	0000	0.57	0.00	03.72	00.152	14.45	1.40	1.18	1.28	000.000	00.000
07.30	018	251	474	00.54	1.26	0000	0000	0.43	0.00	02.44	00.174	15.13	1.35	1.41	1.37	000.000	00.000
08.00	012	233	384	00.53	1.27	0000	0000	0.31	0.00	01.82	00.181	15.82	1.38	1.34	1.39	000.000	00.000
08.30	019	237	324	00.51	1.27	0000	0000	0.22	0.00	01.54	00.179	[illegible]	1.31	1.22	1.23	000.000	00.000
09.00	018	185	303	00.54	1.17	0000	0000	0.25	0.00	01.77	00.169	[illegible]	1.37	1.31	1.23	000.000	00.000
09.30	019	178	[illegible]	00.42	1.23	0000	0000	0.26	0.00	01.13	00.155	[illegible]	1.41	1.28	1.23	000.000	00.000
10.00	018	179	313	00.49	1.24	0000	0000	0.27	0.00	01.02	00.145	15.48	1.32	1.23	1.23	000.000	00.000
10.30	019	162	324	00.47	1.22	0000	0000	0.21	0.00	00.55	00.144	16.15	1.27	1.37	1.22	000.000	00.000
11.00	018	157	297	00.47	1.25	0000	0000	0.20	0.00	00.69	00.144	16.23	1.41	1.42	1.20	000.000	00.000
11.30	019	148	275	00.48	1.17	0000	0000	0.19	0.00	00.22	00.110	16.27	1.37	1.43	1.23	000.000	00.000
12.00	018	143	263	00.46	1.18	0000	0000	0.18	0.00	00.74	00.103	16.31	1.34	1.34	1.21	000.000	00.000
12.30	018	135	263	00.46	1.17	0000	0000	0.17	0.00	00.80	00.107	[illegible]	1.33	1.36	1.23	000.000	00.000
13.00	018	134	251	00.46	1.14	0000	0000	0.17	0.00	00.57	00.098	16.40	1.33	1.37	1.23	000.000	00.000
13.30	018	127	245	00.45	1.12	0000	0000	0.16	0.00	00.54	00.093	16.43	1.29	1.31	1.17	000.000	00.000
14.00	018	122	228	00.44	1.08	0000	0000	0.15	0.00	00.46	00.093	16.45	1.28	1.34	1.16	000.000	00.000
14.30	019	117	216	00.44	1.08	0000	0000	0.15	0.00	00.37	00.092	[illegible]	1.22	1.22	1.15	000.000	00.000
15.00	018	113	205	00.44	1.06	0000	0000	0.15	0.00	00.32	00.090	16.56	1.15	1.23	1.16	000.000	00.000
15.30	018	106	194	00.44	1.03	0000	0000	0.15	0.00	00.32	00.086	16.57	1.16	1.24	1.16	000.000	00.000
16.00	018	105	186	00.42	1.02	0000	0000	0.14	0.00	00.32	00.085	16.56	1.14	1.23	1.14	000.000	00.000
16.30	018	100	174	00.41	1.00	0000	0000	0.14	0.00	00.24	00.083	16.61	1.12	1.16	1.14	000.000	00.000
17.00	018	098	172	00.44	0.90	0000	0000	0.14	0.00	00.22	00.081	16.65	1.12	1.14	1.12	000.000	00.000
17.30	018	095	159	00.43	1.00	0000	0000	0.14	0.00	00.23	00.079	16.67	1.10	1.11	1.12	000.000	00.000
18.00	018	092	158	00.42	0.98	0000	0000	0.13	0.00	00.13	00.075	16.67	1.06	1.39	1.11	000.000	00.000
18.30	018	090	151	00.41	0.97	0000	0000	0.13	0.00	00.16	00.073	16.69	1.09	1.40	1.10	000.000	00.000
19.00	018	087	145	00.41	0.96	0000	0000	0.13	0.00	00.14	00.069	16.74	1.07	1.09	1.11	000.000	00.000
19.30	018	086	137	00.43	0.95	0000	0000	0.13	0.00	00.14	00.066	16.74	1.07	1.07	1.11	000.000	00.000
20.00	018	083	133	00.42	0.95	0000	0000	0.13	0.00	00.12	00.065	16.97	1.05	1.05	1.10	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	022	022	00.26	0.00	0000	0000	0.00	0.00	00.78	00.044	20.23	0.00	0.00	0.00	000.000	00.000
00.30	013	042	061	00.25	0.00	0000	0000	0.09	0.00	00.51	00.033	20.13	0.00	0.00	0.00	000.000	00.000
01.00	013	052	101	00.33	0.01	0000	0000	0.10	0.00	00.66	00.043	19.77	0.00	0.00	0.00	000.000	00.000
01.30	013	077	139	00.36	0.02	0000	0000	0.11	0.00	01.10	00.045	19.63	0.00	0.00	0.00	000.000	00.000
02.00	013	100	196	00.42	0.02	0000	0000	0.14	0.00	01.48	00.044	18.73	0.01	0.00	0.00	000.000	00.000
02.30	014	135	290	00.48	0.01	0000	0000	0.17	0.00	02.41	00.041	18.00	0.01	0.01	0.01	000.000	00.000
03.00	014	182	428	00.55	0.05	0000	0000	0.19	0.00	03.26	00.044	17.26	0.01	0.01	0.01	000.000	00.000
03.30	014	239	616	00.63	0.13	0000	0000	0.19	0.00	04.27	00.044	15.76	0.03	0.31	0.32	000.000	00.000
04.00	014	290	766	[illegible]	0.16	0000	0000	0.23	0.00	04.41	00.049	13.53	0.07	0.33	0.34	000.000	00.000
04.30	014	300	755	00.68	0.56	0000	0000	0.34	0.00	05.33	00.057	12.87	0.17	0.33	0.10	000.000	00.000
05.00	014	324	824	00.58	0.83	0000	0000	0.47	0.00	05.54	00.090	12.19	0.27	0.25	0.31	000.000	00.000
05.30	014	322	844	00.69	0.86	0000	0000	0.69	0.00	08.08	00.194	09.87	0.79	0.52	0.57	000.000	00.000
06.00	015	337	855	00.57	0.24	0000	0000	0.78	0.00	11.71	00.364	05.50	1.45	0.74	0.28	000.000	00.000
06.30	015	335	811	00.61	0.41	0000	0000	1.27	0.00	11.22	00.743	14.41	1.08	0.97	1.03	000.000	00.000
07.00	015	300	684	00.57	0.26	0000	0000	1.20	0.00	09.98	01.222	11.73	1.19	1.01	1.02	000.000	00.000
07.30	014	267	572	00.63	0.48	0000	0000	1.14	0.00	08.45	01.321	12.62	1.07	0.95	1.01	000.000	00.000
08.00	015	244	506	00.61	0.41	0000	0000	1.38	0.00	07.77	01.179	13.74	1.11	1.00	1.00	000.000	00.000
08.30	015	211	454	00.62	0.00	0000	0000	0.96	0.00	06.23	01.239	14.79	1.17	1.05	1.09	000.000	00.000
09.00	015	189	410	00.64	0.07	0000	0000	0.90	0.00	04.76	01.124	16.96	1.14	1.00	1.07	000.000	00.000
09.30	015	177	390	00.63	0.08	0000	0000	0.34	0.00	02.99	00.974	17.99	1.13	0.99	1.00	000.000	00.000
10.00	015	173	368	00.67	0.43	0000	0000	0.60	0.00	02.35	01.017	18.46	1.12	1.03	0.99	000.000	00.000
10.30	015	167	356	00.64	0.08	0000	0000	0.79	0.00	02.14	00.725	18.69	1.09	0.97	0.99	000.000	00.000
11.00	015	158	341	00.54	0.38	0000	0000	0.67	0.00	01.35	00.08	15.89	1.12	0.94	1.01	000.000	00.000
11.30	015	154	319	00.60	0.11	0000	0000	0.62	0.00	01.38	00.075	18.87	1.17	0.94	0.94	000.000	00.000
12.00	015	141	293	00.57	0.10	0000	0000	0.57	0.00	01.69	00.270	18.74	1.15	0.93	0.96	000.000	00.000
12.30	015	135	276	00.53	0.13	0000	0000	0.53	0.00	01.79	00.057	18.99	1.15	0.89	0.93	000.000	00.000
13.00	015	134	263	00.53	0.17	0000	0000	0.19	0.00	01.67	00.084	18.97	1.19	0.92	0.28	000.000	00.000
13.30	015	127	254	00.56	0.19	0000	0000	0.17	0.00	01.69	00.113	19.06	1.29	0.58	0.91	000.000	00.000
14.00	015	121	236	00.55	0.16	0000	0000	0.16	0.00	01.63	00.124	19.24	1.07	0.83	0.28	000.000	00.000
14.30	015	118	224	00.53	0.20	0000	0000	0.15	0.00	01.44	00.143	19.20	0.90	0.87	0.94	000.000	00.000
15.00	015	114	211	00.54	0.22	0000	0000	0.15	0.00	01.42	00.137	19.32	1.03	0.25	0.25	000.000	00.000
15.30	015	112	219	00.54	0.21	0000	0000	0.15	0.00	01.42	00.141	19.33	1.04	0.85	0.23	000.000	00.000
16.00	015	109	190	00.51	0.23	0000	0000	0.14	0.00	01.34	00.161	19.43	1.07	0.32	0.67	000.000	00.000
16.30	015	104	193	00.52	0.26	0000	0000	0.14	0.00	01.27	00.155	19.52	1.04	0.51	0.24	000.000	00.000
17.00	015	101	191	00.52	0.24	0000	0000	0.14	0.00	01.17	00.165	19.58	1.02	0.83	0.83	000.000	00.000
17.30	015	098	155	00.51	0.25	0000	0000	0.14	0.00	01.11	00.197	19.61	1.02	0.25	0.35	000.000	00.000
18.00	015	097	173	00.51	0.39	0000	0000	0.14	0.00	01.39	00.178	20.47	1.01	0.83	0.85	000.000	00.000
18.30	015	095	175	00.51	0.26	0000	0000	0.14	0.00	00.45	00.183	20.45	1.00	0.83	0.94	000.000	00.000
19.00	015	092	167	00.54	0.37	0000	0000	0.14	0.00	00.41	00.173	20.59	0.73	0.83	0.64	000.000	00.000
19.30	015	090	163	00.50	0.39	0000	0000	0.13	0.00	00.34	00.165	20.47	0.95	0.83	0.64	000.000	00.000
20.00	015	087	160	00.50	0.30	0000	0000	0.13	0.00	00.29	00.168	20.33	0.72	0.20	0.82	000.000	00.000

TABLE 6: Small crib - 1 m corridor - 10 cm opening (cont.).

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	020	046	055	00.00	00.2	0000	0000	0.11	0.00	00.00	00.041	21.35	0.00	0.00	0.00	000.000	00.000
00.30	020	064	093	00.22	00.1	0000	0000	0.11	0.00	00.00	00.040	21.37	0.00	0.00	0.00	000.000	00.000
01.00	020	103	177	00.34	00.1	0000	0000	0.12	0.00	00.14	00.044	21.23	0.00	0.00	0.00	000.000	00.000
01.30	020	227	419	00.45	00.0	0000	0000	0.14	0.00	00.58	00.049	20.67	0.00	0.00	0.00	000.000	00.000
02.00	019	340	631	00.59	00.3	0001	0000	0.17	0.00	02.04	00.057	20.33	0.00	0.00	0.00	000.000	00.000
02.30	020	406	713	00.60	01.4	0003	0000	0.21	0.00	03.76	00.090	19.77	0.00	0.00	0.00	000.000	00.000
03.00	020	457	685	00.61	01.5	0003	0000	0.35	0.00	05.13	00.194	17.42	0.00	0.00	0.00	000.000	00.000
03.30	019	464	647	00.63	07.3	0017	0003	0.71	0.00	06.48	00.364	16.25	0.00	0.00	0.00	000.000	00.000
04.00	019	484	702	00.57	09.7	0022	0012	0.85	0.00	07.77	00.743	15.44	0.00	0.00	0.00	000.000	00.000
04.30	019	494	732	00.55	08.2	0012	0022	0.88	0.00	08.33	01.232	14.11	0.00	0.00	0.00	000.000	00.000
05.00	019	493	729	00.54	07.7	0017	0030	0.67	0.00	08.09	01.425	13.66	0.00	0.00	0.00	000.000	00.000
05.30	020	469	669	00.56	03.4	0007	0035	0.45	0.00	07.23	01.179	14.27	0.00	0.00	0.00	000.000	00.000
06.00	019	422	621	00.57	01.5	0003	0036	0.35	0.00	06.11	01.239	15.07	0.00	0.00	0.00	000.000	00.000
06.30	019	350	499	00.49	00.4	0001	0036	0.32	0.00	03.72	01.126	16.34	0.00	0.00	0.00	000.000	00.000
07.00	019	306	461	00.49	00.5	0001	0035	0.31	0.00	02.37	00.974	18.37	0.00	0.00	0.00	000.000	00.000
07.30	019	273	426	00.39	00.0	0000	0035	0.24	0.00	01.72	01.017	19.07	0.00	0.00	0.00	000.000	00.000
08.00	019	259	416	00.47	00.5	0001	0036	0.27	0.00	01.53	00.725	19.45	0.00	0.00	0.00	000.000	00.000
08.30	019	246	406	00.46	00.1	0000	0036	0.25	0.00	01.41	00.08	19.66	0.00	0.00	0.00	000.000	00.000
09.00	019	236	380	00.45	00.4	0000	0036	0.22	0.00	01.34	00.035	19.57	0.00	0.00	0.00	000.000	00.000
09.30	019	224	373	00.48	00.3	0000	0036	0.22	0.00	01.26	00.029	19.33	0.00	0.00	0.00	000.000	00.000
10.00	019	214	355	00.46	00.1	0000	0036	0.22	0.00	01.11	00.057	20.07	0.00	0.00	0.00	000.000	00.000
10.30	019	208	343	00.44	00.0	0000	0036	0.20	0.00	00.95	00.084	20.18	0.00	0.00	0.00	000.000	00.000
11.00	019	200	348	00.43	00.1	0000	0036	0.20	0.00	00.71	00.113	20.09	0.00	0.00	0.00	000.000	00.000

TABLE 7: Small crib - 2 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	018	017	00.25	0.00	0000	0000	0.09	0.00	00.00	00.000	20.74	0.00	0.00	0.00	000.000	00.000
00.30	013	021	025	00.19	0.00	0000	0000	0.09	0.00	00.00	00.000	20.75	0.00	0.00	0.00	000.000	00.000
01.00	013	055	040	00.30	0.00	0000	0000	0.09	0.00	00.21	00.000	20.58	0.00	0.00	0.00	000.000	00.000
01.30	013	064	054	00.34	0.00	0000	0000	0.09	0.00	00.22	00.000	20.33	0.00	0.00	0.00	000.000	00.000
02.00	013	061	075	00.36	0.00	0000	0000	0.10	0.00	00.33	00.000	20.11	0.00	0.00	0.00	000.000	00.000
02.30	013	067	109	00.42	0.00	0000	0000	0.10	0.00	00.79	00.000	19.74	0.00	0.00	0.00	000.000	00.000
03.00	013	078	149	00.48	0.00	0000	0000	0.11	0.00	01.46	00.003	19.32	0.00	0.00	0.00	000.000	00.000
03.30	013	087	176	00.53	0.01	0000	0000	0.11	0.00	01.91	00.004	18.35	0.00	0.00	0.01	000.000	00.000
04.00	013	102	337	00.60	0.01	0000	0000	0.12	0.00	02.74	00.090	18.41	0.00	0.00	0.01	000.000	00.000
04.30	013	111	485	00.64	0.01	0000	0000	0.14	0.00	03.21	00.093	17.75	0.02	0.01	0.02	000.000	00.000
05.00	013	125	613	00.67	0.02	0000	0000	0.17	0.00	03.77	00.097	16.76	0.03	0.02	0.04	000.000	00.000
05.30	013	135	674	00.72	0.05	0000	0000	0.21	0.00	04.23	00.1	16.37	0.06	0.03	0.05	000.000	00.000
06.00	013	150	755	00.79	0.07	0000	0000	0.35	0.00	04.59	00.205	16.15	0.08	0.05	0.08	000.000	00.000
06.30	013	190	821	00.85	0.09	0000	0000	0.71	0.00	05.55	00.095	15.49	0.12	0.08	0.19	000.000	00.000
07.00	013	157	498	00.70	0.14	0000	0000	0.25	0.00	05.33	00.139	14.39	0.20	0.11	0.21	000.000	00.000
07.30	013	153	461	00.86	0.21	0000	0000	0.38	0.00	05.72	00.194	14.44	0.27	0.19	0.25	000.000	00.000
08.00	013	147	373	00.91	0.31	0000	0000	0.67	0.00	04.97	00.124	14.75	0.37	0.26	0.36	000.000	00.000
08.30	013	140	258	00.88	0.37	0000	0000	0.45	0.00	03.46	00.106	16.33	0.37	0.23	0.35	000.000	00.000
09.00	013	134	205	00.86	0.42	0000	0000	0.35	0.00	02.05	00.124	17.29	0.35	0.33	0.33	000.000	00.000
09.30	013	123	193	00.86	0.42	0000	0000	0.32	0.00	01.67	00.147	18.63	0.34	0.37	0.30	000.000	00.000
10.00	013	123	188	00.80	0.42	0000	0000	0.31	0.00	01.55	00.155	18.71	0.33	0.39	0.25	000.000	00.000
10.30	013	119	165	00.77	0.42	0000	0000	0.24	0.00	01.38	00.155	19.09	0.32	0.41	0.27	000.000	00.000
11.00	013	115	160	00.78	0.36	0000	0000	0.27	0.00	01.30	00.155	19.24	0.34	0.37	0.27	000.000	00.000
11.30	013	112	155	00.77	0.36	0000	0000	0.25	0.00	01.19	00.159	19.33	0.32	0.37	0.27	000.000	00.000
12.00	013	108	144	00.75	0.34	0000	0000	0.22	0.00	01.11	00.144	19.36	0.33	0.41	0.26	000.000	00.000
12.30	013	105	137	00.72	0.33	0000	0000	0.22	0.00	01.00	00.143	19.45	0.32	0.39	0.27	000.000	00.000
13.00	013	102	140	00.72	0.32	0000	0000	0.22	0.00	00.97	00.133	19.55	0.33	0.37	0.26	000.000	00.000
13.30	013	099	130	00.69	0.31	0000	0000	0.20	0.00	00.84	00.123	19.56	0.33	0.37	0.27	000.000	00.000
14.00	013	096	134	00.67	0.31	0000	0000	0.20	0.00	00.73	00.125	19.75	0.31	0.35	0.27	000.000	00.000
14.30	013	094	136	00.69	0.31	0000	0000	0.13	0.00	00.73	00.121	19.30	0.30	0.33	0.27	000.000	00.000
15.00	013	091	132	00.68	0.31	0000	0000	0.13	0.00	00.65	00.122	19.35	0.31	0.34	0.27	000.000	00.000
15.30	013	089	127	00.67	0.31	0000	0000	0.19	0.00	00.60	00.116	19.74	0.32	0.33	0.27	000.000	00.000
16.00	013	087	118	00.63	0.31	0000	0000	0.17	0.00	00.55	00.115	19.90	0.32	0.33	0.27	000.000	00.000
16.30	013	084	114	00.62	0.31	0000	0000	0.18	0.00	00.45	00.105	20.12	0.31	0.31	0.27	000.000	00.000
17.00	013	062	111	00.62	0.31	0000	0000	0.16	0.00	00.43	00.103	20.12	0.31	0.31	0.27	000.000	00.000
17.30	013	062	106	00.62	0.31	0000	0000	0.16	0.00	00.40	00.100	20.11	0.31	0.30	0.27	000.000	00.000
18.00	013	059	104	00.60	0.30	0000	0000	0.15	0.00	00.33	00.090	20.21	0.31	0.29	0.27	000.000	00.000
18.30	013	061	099	00.59	0.30	0000	0000	0.14	0.00	00.30	00.096	20.22	0.31	0.29	0.27	000.000	00.000
19.00	013	065	096	00.57	0.30	0000	0000	0.13	0.00	00.23	00.097	20.23	0.31	0.29	0.27	000.000	00.000
19.30	013	062	093	00.57	0.30	0000	0000	0.14	0.00	00.26	00.095	20.31	0.31	0.23	0.27	000.000	00.000
20.00	013	054	091	00.55	0.30	0000	0000	0.12	0.00	00.22	00.094	20.32	0.31	0.23	0.27	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	000	012	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	20.74	0.00	0.00	0.00	000.000	00.000
00.30	009	009	032	00.24	0.00	0000	0000	0.00	0.00	00.00	00.000	20.95	0.00	0.00	0.00	000.000	00.000
01.00	009	021	059	00.37	0.00	0000	0000	0.07	0.00	00.24	00.000	20.68	0.00	0.00	0.00	000.000	00.000
01.30	009	039	106	00.37	0.00	0000	0000	0.08	0.00	00.51	00.000	20.43	0.00	0.00	0.00	000.000	00.000
02.00	009	077	179	00.49	0.00	0000	0000	0.11	0.00	01.07	00.074	20.49	0.00	0.00	0.00	000.000	00.000
02.30	009	120	275	00.58	0.00	0000	0000	0.15	0.00	01.75	00.074	19.50	0.01	0.01	0.00	000.000	00.000
03.00	009	156	363	00.62	0.00	0000	0000	0.19	0.00	02.69	00.075	19.79	0.00	0.01	0.01	000.000	00.000
03.30	009	189	444	00.71	0.00	0000	0000	0.30	0.00	03.14	00.093	17.99	0.02	0.01	0.03	000.000	00.000
04.00	010	214	509	00.89	0.00	0000	0000	0.43	0.00	03.37	00.059	17.39	0.04	0.04	0.04	000.000	00.000
04.30	010	242	573	00.83	0.00	0000	0000	0.64	0.00	04.23	00.091	16.75	0.06	0.05	0.07	000.000	00.000
05.00	010	261	652	00.86	0.00	0000	0000	0.33	0.00	04.56	00.096	16.59	0.09	0.08	0.10	000.000	00.000
05.30	010	280	658	00.91	0.00	0000	0000	1.04	0.00	05.05	00.092	16.10	0.13	0.13	0.16	000.000	00.000
06.00	010	273	632	00.90	0.00	0000	0000	0.91	0.00	04.92	00.028	15.21	0.14	0.18	0.19	000.000	00.000
06.30	010	266	558	00.87	0.00	0000	0000	0.87	0.00	04.67	00.092	15.79	0.17	0.22	0.23	000.000	00.000
07.00	010	251	491	00.90	0.00	0000	0000	0.79	0.00	03.91	00.095	16.66	0.20	0.25	0.28	000.000	00.000
07.30	010	222	405	00.91	0.00	0000	0000	0.53	0.00	02.73	00.099	17.40	0.23	0.39	0.34	000.000	00.000
08.00	010	186	333	00.86	0.00	0000	0000	0.40	0.00	01.79	00.197	19.34	0.19	0.32	0.33	000.000	00.000
08.30	010	153	293	00.81	0.00	0000	0000	0.33	0.00	01.23	00.127	19.12	0.22	0.33	0.31	000.000	00.000
09.00	010	144	276	00.76	0.00	0000	0000	0.32	0.00	01.07	00.149	19.52	0.18	0.34	0.30	000.000	00.000
09.30	010	132	273	00.77	0.00	0000	0000	0.27	0.00	00.75	00.153	19.62	0.17	0.34	0.31	000.000	00.000
10.00	010	124	277	00.77	0.00	0000	0000	0.26	0.00	00.83	00.159	19.73	0.19	0.34	0.31	000.000	00.000
10.30	010	119	268	00.67	0.00	0000	0000	0.23	0.00	00.70	00.143	19.35	0.20	0.33	0.30	000.000	00.000
11.00	010	113	254	00.79	0.00	0000	0000	0.20	0.00	00.52	00.133	20.00	0.19	0.33	0.31	000.000	00.000
11.30	010	107	240	00.68	0.00	0000	0000	0.21	0.00	00.45	00.130	20.11	0.16	0.34	0.23	000.000	00.000
12.00	010	102	225	00.68	0.00	0000	0000	0.17	0.00	00.33	00.126	20.18	0.15	0.33	0.29	000.000	00.000
12.30	010	099	211	00.56	0.00	0000	0000	0.17	0.00	00.25	00.119	20.26	0.14	0.33	0.29	000.000	00.000
13.00	010	093	200	00.62	0.00	0000	0000	0.16	0.00	00.21	00.114	20.33	0.14	0.34	0.28	000.000	00.000
13.30	010	088	190	00.62	0.00	0000	0000	0.14	0.00	00.11	00.105	20.38	0.16	0.33	0.28	000.000	00.000
14.00	010	083	180	00.61	0.00	0000	0000	0.14	0.00	00.06	00.102	20.45	0.16	0.32	0.29	000.000	00.000
14.30	010	080	173	00.57	0.00	0000	0000	0.14	0.00	00.00	00.098	20.49	0.15	0.31	0.29	000.000	00.000
15.00	010	077	164	00.62	0.00	0000	0000	0.14	0.00	00.00	00.094	20.53	0.14	0.31	0.27	000.000	00.000
15.30	010	072	157	00.59	0.00	0000	0000	0.14	0.00	00.00	00.093	20.58	0.15	0.31	0.29	000.000	00.000
16.00	010	070	150	00.53	0.00	0000	0000	0.14	0.00	00.00	00.091	20.62	0.15	0.30	0.29	000.000	00.000
16.30	010	067	143	00.59	0.00	0000	0000	0.12	0.00	00.00	00.099	20.66	0.14	0.30	0.29	000.000	00.000
17.00	010	065	138	00.59	0.00	0000	0000	0.13	0.00	00.00	00.099	20.69	0.13	0.30	0.29	000.000	00.000
17.30	010	062	132	00.55	0.00	0000	0000	0.11	0.00	00.00	00.000	20.71	0.14	0.27	0.28	000.000	00.000
18.00	010	060	127	00.55	0.00	0000	0000	0.13	0.00	00.00	00.000	20.73	0.14	0.30	0.28	000.000	00.000
18.30	010	058	124	00.52	0.00	0000	0000	0.12	0.00	00.00	00.000	20.74	0.14	0.27	0.28	000.000	00.000
19.00	010	057	129	00.53	0.00	0000	0000	0.10	0.00	00.00	00.000	20.75	0.13	0.29	0.28	000.000	00.000
19.30	010	054	117	00.53	0.00	0000	0000	0.10	0.00	00.00	00.000	20.76	0.14	0.29	0.27	000.000	00.000
20.00	010	053	113	00.51	0.00	0000	0000	0.08	0.00	00.00	00.000	20.75	0.13	0.27	0.27	000.000	00.000

TABLE 7: Small crib - 2 m corridor - 40 cm opening (cont.).

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	021	032	00.00	00.0	0000	0000	0.02	0.00	00.00	00.000	21.25	0.00	0.00	0.00	000.000	00.000
00.30	013	034	057	00.23	00.0	0000	0000	0.02	0.00	00.00	00.000	21.41	0.00	0.00	0.00	000.000	00.000
01.00	013	052	082	00.37	00.0	0000	0000	0.04	0.00	00.25	00.000	21.29	0.00	0.00	0.00	000.000	00.000
01.30	013	073	137	00.44	00.0	0000	0000	0.04	0.00	00.38	00.000	20.52	0.00	0.00	0.00	000.000	00.000
02.00	013	111	206	00.50	00.0	0000	0000	0.05	0.00	01.51	00.000	20.36	0.00	0.00	0.00	000.000	00.000
02.30	013	142	262	00.57	00.2	0000	0000	0.10	0.00	02.28	00.000	19.54	0.00	0.00	0.00	000.000	00.000
03.00	013	185	498	00.67	00.0	0000	0000	0.16	0.00	03.08	00.124	18.79	0.00	0.00	0.00	000.000	00.000
03.30	013	209	441	00.84	01.3	0004	0000	0.23	0.00	04.63	00.114	17.32	0.00	0.00	0.00	000.000	00.000
04.00	013	233	503	00.79	02.5	0007	0002	0.33	0.00	05.15	00.116	16.49	0.00	0.00	0.00	000.000	00.000
04.30	013	233	542	00.93	01.6	0004	0004	0.40	0.00	05.36	00.111	16.09	0.00	0.00	0.00	000.000	00.000
05.00	013	257	574	00.86	01.1	0003	0006	0.46	0.00	05.39	00.114	15.73	0.00	0.00	0.00	000.000	00.000
05.30	013	277	603	01.04	03.4	0010	0010	0.54	0.00	06.22	00.116	15.37	0.00	0.00	0.00	000.000	00.000
06.00	013	278	579	00.91	01.7	0005	0012	0.54	0.00	06.49	00.121	15.22	0.00	0.00	0.00	000.000	00.000
06.30	013	270	517	00.87	02.2	0006	0019	0.51	0.00	06.24	00.121	14.73	0.00	0.00	0.00	000.000	00.000
07.00	013	250	459	00.95	02.0	0005	0022	0.43	0.00	05.47	00.124	15.03	0.00	0.00	0.00	000.000	00.000
07.30	013	230	394	00.91	00.6	0001	0024	0.33	0.00	04.67	00.133	15.75	0.00	0.00	0.00	000.000	00.000
08.00	013	199	306	00.26	00.1	0000	0024	0.24	0.00	03.72	00.133	16.67	0.00	0.00	0.00	000.000	00.000
08.30	013	167	232	00.34	00.0	0000	0024	0.19	0.00	02.62	00.153	17.71	0.00	0.00	0.00	000.000	00.000
09.00	013	152	210	00.77	00.0	0000	0024	0.16	0.00	01.72	00.170	18.63	0.00	0.00	0.00	000.000	00.000
09.30	013	145	202	00.73	00.0	0000	0024	0.16	0.00	01.40	00.131	19.43	0.00	0.00	0.00	000.000	00.000
10.00	013	136	183	00.75	00.0	0000	0024	0.12	0.00	01.42	00.127	19.63	0.00	0.00	0.00	000.000	00.000
10.30	013	130	177	00.72	00.0	0000	0024	0.13	0.00	01.13	00.173	19.77	0.00	0.00	0.00	000.000	00.000
11.00	013	124	183	00.77	00.1	0000	0024	0.12	0.00	01.22	00.162	19.90	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	033	047	00.00	00.0	0000	0000	0.02	0.00	00.00	00.000	21.23	0.00	0.00	0.00	000.000	00.000
00.30	013	049	076	00.41	00.2	0000	0000	0.04	0.00	00.00	00.000	21.36	0.00	0.01	0.00	000.000	00.000
01.00	013	068	105	00.48	00.0	0000	0000	0.04	0.00	00.47	00.000	20.92	0.00	0.00	0.00	000.000	00.000
01.30	013	093	145	00.53	00.1	0000	0000	0.04	0.00	00.96	00.000	20.72	0.00	0.00	0.00	000.000	00.000
02.00	013	122	199	00.60	00.0	0000	0000	0.06	0.00	01.59	00.000	19.95	0.00	0.00	0.00	000.000	00.000
02.30	013	153	279	00.62	00.0	0000	0000	0.09	0.00	02.38	00.075	19.40	0.00	0.00	0.00	000.000	00.000
03.00	013	182	337	00.74	00.2	0000	0000	0.13	0.00	03.30	00.079	18.72	0.00	0.00	0.00	000.000	00.000
03.30	013	204	395	00.89	01.2	0003	0000	0.19	0.00	04.19	00.089	18.11	0.00	0.00	0.00	000.000	00.000
04.00	013	233	510	00.83	01.4	0003	0000	0.25	0.00	04.61	00.092	17.35	0.00	0.00	0.00	000.000	00.000
04.30	013	264	597	00.84	03.1	0007	0004	0.37	0.00	05.54	00.095	16.32	0.00	0.00	0.00	000.000	00.000
05.00	013	287	659	00.92	02.8	0009	0009	0.45	0.00	06.75	00.101	15.34	0.00	0.00	0.00	000.000	00.000
05.30	013	295	633	00.71	05.0	0014	0013	0.51	0.00	07.33	00.108	14.70	0.00	0.00	0.00	000.000	00.000
06.00	013	293	618	00.81	03.5	0009	0018	0.50	0.00	07.28	00.109	14.21	0.00	0.00	0.00	000.000	00.000
06.30	013	277	532	00.86	03.9	0010	0022	0.43	0.00	06.89	00.116	14.26	0.00	0.00	0.00	000.000	00.000
07.00	013	253	433	00.30	01.3	0004	0025	0.34	0.00	05.44	00.115	14.34	0.00	0.00	0.00	000.000	00.000
07.30	013	223	362	00.87	00.9	0002	0025	0.25	0.00	04.16	00.124	16.08	0.00	0.00	0.00	000.000	00.000
08.00	013	188	276	00.79	00.3	0001	0025	0.19	0.00	03.01	00.141	17.29	0.00	0.00	0.00	000.000	00.000
08.30	013	167	242	00.76	00.2	0000	0025	0.16	0.00	02.09	00.164	18.23	0.00	0.00	0.00	000.000	00.000
09.00	013	157	227	00.75	00.0	0000	0025	0.15	0.00	01.30	00.139	19.29	0.00	0.00	0.00	000.000	00.000
09.30	013	149	214	00.71	00.0	0000	0025	0.13	0.00	01.65	00.137	19.47	0.00	0.00	0.00	000.000	00.000
10.00	013	142	209	00.77	00.0	0000	0025	0.13	0.00	01.43	00.126	19.53	0.00	0.00	0.00	000.000	00.000
10.30	013	137	195	00.77	00.0	0000	0025	0.11	0.00	01.32	00.133	19.66	0.00	0.00	0.00	000.000	00.000
11.00	013	132	192	00.76	00.0	0000	0025	0.11	0.00	01.23	00.186	19.83	0.00	0.00	0.00	000.000	00.000

TABLE 8: Small cribs - 2 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	017	024	019	00.11	0.00	0000	0000	0.09	0.00	00.00	00.000	20.76	0.00	0.00	0.00	000.000	00.000
00.30	017	039	050	00.27	0.00	0000	0000	0.09	0.00	00.00	00.000	20.75	0.00	0.00	0.01	000.000	00.000
01.00	017	056	067	00.33	0.20	0000	0000	0.00	0.00	00.40	00.000	20.47	0.00	0.00	0.01	000.000	00.000
01.30	017	074	100	00.37	0.00	0000	0000	0.00	0.00	00.75	00.057	20.09	0.00	0.00	0.01	000.000	00.000
02.00	017	101	114	00.44	0.00	0000	0000	0.10	0.00	01.27	00.101	19.64	0.00	0.00	0.02	000.000	00.000
02.30	016	157	143	00.51	0.00	0000	0000	0.11	0.00	02.13	00.102	19.01	0.01	0.00	0.02	000.000	00.000
03.00	016	204	169	00.55	0.01	0000	0000	0.13	0.00	03.32	00.111	17.84	0.02	0.00	0.02	000.000	00.000
03.30	017	259	276	00.65	0.03	0000	0000	0.19	0.00	04.57	00.195	16.52	0.04	0.01	0.04	000.000	00.000
04.00	017	300	400	00.68	0.06	0000	0000	0.50	0.00	04.72	00.147	14.73	0.12	0.04	0.12	000.000	00.000
04.30	017	294	462	00.66	0.15	0000	0000	0.63	0.00	05.39	00.540	12.87	0.33	0.11	0.33	000.000	00.000
05.00	017	275	530	00.68	0.46	0000	0000	0.60	0.00	08.47	00.636	11.58	0.89	0.40	0.63	000.000	00.000
05.30	017	299	493	00.60	0.87	0000	0000	0.77	0.00	07.32	00.742	12.17	1.17	0.83	1.40	000.000	00.000
06.00	017	303	567	00.68	1.28	0000	0000	0.73	0.00	07.23	00.720	12.67	1.57	1.17	1.77	000.000	00.000
06.30	017	296	473	00.65	1.59	0000	0000	0.57	0.00	05.19	[illegible]	[illegible]	1.34	1.54	1.33	000.000	00.000
07.00	017	289	405	00.60	1.51	0000	0000	0.33	0.00	03.12	00.114	[illegible]	1.17	1.40	1.09	000.000	00.000
07.30	017	231	344	00.57	1.42	0000	0000	0.27	0.00	02.30	00.137	[illegible]	1.28	1.42	1.05	000.000	00.000
08.00	017	210	314	00.62	1.51	0000	0000	0.22	0.00	01.59	00.143	[illegible]	1.15	1.41	1.02	000.000	00.000
08.30	017	195	273	00.57	1.50	0000	0000	0.24	0.00	01.45	00.149	[illegible]	1.29	1.47	0.99	000.000	00.000
09.00	017	183	276	00.60	1.49	0000	0000	0.22	0.00	01.29	00.155	19.74	1.17	1.53	0.91	000.000	00.000
09.30	017	172	255	00.56	1.37	0000	0000	0.19	0.00	01.09	00.149	19.57	1.22	1.53	1.04	000.000	00.000
10.00	017	166	243	00.56	1.20	0000	0000	0.21	0.00	00.60	00.142	19.67	1.17	1.53	1.06	000.000	00.000
10.30	017	153	231	00.55	1.12	0000	0000	0.17	0.00	00.87	00.143	19.30	1.17	1.53	1.02	000.000	00.000
11.00	017	152	221	00.55	1.16	0000	0000	0.13	0.00	00.30	00.137	19.37	1.47	1.44	1.03	000.000	00.000
11.30	017	145	210	00.53	1.05	0000	0000	0.19	0.00	00.73	00.125	19.73	1.05	1.41	1.03	000.000	00.000
12.00	017	140	202	00.55	1.42	0000	0000	0.16	0.00	00.54	00.125	20.00	1.06	1.41	1.06	000.000	00.000
12.30	017	136	173	00.54	1.30	0000	0000	0.16	0.00	00.63	00.122	20.04	1.05	1.37	1.03	000.000	00.000
13.00	017	132	185	00.53	1.63	0000	0000	0.16	0.00	00.59	00.125	20.09	1.03	1.33	1.03	000.000	00.000
13.30	017	127	179	00.53	1.00	0000	0000	0.15	0.00	00.50	00.112	20.16	1.02	1.29	1.03	000.000	00.000
14.00	017	125	174	00.52	0.90	0000	0000	0.15	0.00	00.45	00.115	20.17	1.06	1.22	1.02	000.000	00.000
14.30	017	120	167	00.52	0.00	0000	0000	0.15	0.00	00.42	00.116	20.25	1.02	1.22	1.03	000.000	00.000
15.00	017	116	152	00.51	0.05	0000	0000	0.16	0.00	00.37	00.113	20.29	1.02	1.19	1.03	000.000	00.000
15.30	017	113	155	00.53	0.97	0000	0000	0.14	0.00	00.33	00.112	20.31	1.01	1.14	1.02	000.000	00.000
16.00	017	110	150	00.50	0.75	0000	0000	0.15	0.00	00.31	00.113	20.33	1.02	1.11	1.01	000.000	00.000
16.30	017	100	143	00.52	0.74	0000	0000	0.13	0.00	00.30	00.111	20.32	1.02	1.08	1.00	000.000	00.000
17.00	017	105	140	00.49	0.04	0000	0000	0.16	0.00	00.25	00.107	20.40	1.02	1.05	0.99	000.000	00.000
17.30	017	103	136	00.43	0.63	0000	0000	0.15	0.00	00.24	00.104	20.43	1.00	1.02	0.97	000.000	00.000
18.00	017	101	134	00.44	0.75	0000	0000	0.15	0.00	00.25	00.107	20.43	1.00	1.02	0.99	000.000	00.000
18.30	017	099	129	00.47	0.62	0000	0000	0.14	0.00	00.19	00.099	20.47	1.00	0.99	0.98	000.000	00.000
19.00	017	095	126	00.45	0.72	0000	0000	0.14	0.00	00.12	00.098	20.54	0.99	0.98	0.98	000.000	00.000
19.30	017	094	122	00.43	0.91	0000	0000	0.13	0.00	00.17	00.095	20.57	0.99	0.97	0.97	000.000	00.000
20.00	017	091	117	00.49	0.99	0000	0000	0.14	0.00	00.14	00.091	20.54	0.99	0.95	0.97	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS kg/MIN
00.00	011	013	002	00.01	0.00	0000	0000	0.08	0.00	00.00	00.000	20.94	0.00	0.00	0.00	000.000	00.000
00.30	011	019	047	00.00	0.01	0000	0000	0.05	0.00	00.00	00.000	20.39	0.00	0.00	0.00	000.000	00.000
01.00	011	032	076	00.20	0.01	0000	0000	0.08	0.00	00.22	00.049	20.54	0.00	0.00	0.00	000.000	00.000
01.30	011	045	100	00.27	0.02	0000	0000	0.00	0.00	00.56	[illegible]	20.13	0.01	0.00	0.00	000.000	00.000
02.00	011	076	205	00.36	0.02	0000	0000	0.10	0.00	00.74	00.045	19.93	0.01	0.00	0.00	000.000	00.000
02.30	011	199	266	00.43	0.02	0000	0000	0.12	0.00	01.84	00.077	19.13	0.01	0.00	0.00	000.000	00.000
03.00	011	145	370	00.52	0.04	0000	0000	0.12	0.00	02.41	00.072	18.45	0.01	0.00	0.00	000.000	00.000
03.30	011	201	579	00.53	0.09	0000	0000	0.23	0.00	03.33	00.082	17.78	0.02	0.01	0.00	000.000	00.000
04.00	011	251	731	00.66	0.09	0000	0000	0.37	0.00	04.77	00.095	16.44	0.05	0.01	0.02	000.000	00.000
04.30	011	287	811	00.71	0.36	0000	0000	0.62	0.00	06.52	00.115	14.77	0.14	0.06	0.05	000.000	00.000
05.00	011	297	772	00.71	0.78	0000	0000	0.67	0.00	07.21	00.347	13.33	0.33	0.15	0.16	000.000	00.000
05.30	011	346	837	00.74	0.76	0000	0000	0.79	0.00	05.00	00.407	12.98	0.38	0.39	0.37	000.000	00.000
06.00	011	301	866	00.76	1.03	0000	0000	0.75	0.00	04.11	00.436	14.15	1.19	0.79	0.95	000.000	00.000
06.30	011	299	834	00.77	0.43	0000	0000	0.66	0.00	05.77	00.235	14.39	1.40	1.11	1.11	000.000	00.000
07.00	011	291	671	00.76	0.10	0000	0000	0.57	0.00	04.21	00.300	15.34	1.20	1.29	1.30	000.000	00.000
07.30	011	246	576	00.71	0.04	0000	0000	0.41	0.00	02.59	00.403	17.32	1.16	1.33	1.19	000.000	00.000
08.00	011	230	405	00.71	0.05	0000	0000	0.34	0.00	01.32	00.124	18.36	1.33	1.34	1.28	000.000	00.000
08.30	012	234	432	00.65	0.02	0000	0000	0.30	0.00	01.34	00.134	19.03	1.18	1.37	1.24	000.000	00.000
09.00	012	193	378	00.65	0.02	0000	0000	0.27	0.00	01.16	00.141	19.33	1.23	1.45	1.15	000.000	00.000
09.30	012	183	374	00.61	0.06	0000	0000	0.25	0.00	01.00	00.137	19.48	1.33	1.38	1.03	000.000	00.000
10.00	012	175	336	00.59	0.07	0000	0000	0.24	0.00	00.92	00.133	19.57	1.31	1.34	1.03	000.000	00.000
10.30	012	167	337	00.59	0.11	0000	0000	0.23	0.00	00.93	00.127	19.66	1.29	1.33	1.00	000.000	00.000
11.00	012	161	317	00.55	0.12	0000	0000	0.23	0.00	00.73	00.127	19.73	1.24	1.27	0.99	000.000	00.000
11.30	012	153	344	00.57	0.13	0000	0000	0.29	0.00	00.63	00.123	19.81	1.19	1.26	0.97	000.000	00.000
12.00	012	147	282	00.55	0.16	0000	0000	0.20	0.00	00.54	00.124	19.70	1.31	1.27	0.95	000.000	00.000
12.30	012	141	266	00.53	0.19	0000	0000	0.17	0.00	00.49	00.121	20.00	1.23	1.25	0.97	000.000	00.000
13.00	012	133	259	00.53	0.23	0000	0000	0.13	0.00	00.36	00.102	20.07	1.15	1.24	0.76	000.000	00.000
13.30	012	129	242	00.53	0.29	0000	0000	0.15	0.00	00.32	00.105	20.12	1.11	1.14	0.95	000.000	00.000
14.00	012	123	234	00.55	0.34	0000	0000	0.17	0.00	00.23	00.102	20.24	1.09	1.14	1.01	000.000	00.000
14.30	012	121	219	00.53	0.27	0000	0000	0.18	0.00	00.20	00.100	20.23	1.15	1.10	0.92	000.000	00.000
15.00	012	117	210	00.53	0.24	0000	0000	0.16	0.00	00.15	[illegible]	20.31	1.12	1.10	0.87	000.000	00.000
15.30	012	113	205	00.52	0.24	0000	0000	0.16	0.00	00.13	[illegible]	20.34	1.16	1.06	0.94	000.000	00.000
16.00	012	110	193	00.53	0.27	0000	0000	0.17	0.00	00.07	00.095	20.38	1.05	1.07	0.90	000.000	00.000
16.30	012	106	157	00.53	0.33	0000	0000	0.15	0.00	00.06	00.093	20.42	1.10	1.03	0.93	000.000	00.000
17.00	012	103	177	00.54	0.29	0000	0000	0.15	0.00	00.03	00.099	20.44	1.07	1.09	0.90	000.000	00.000
17.30	012	101	175	00.53	0.33	0000	0000	0.14	0.00	00.00	00.096	20.46	1.13	1.30	0.92	000.000	00.000
18.00	012	099	168	00.52	0.36	0000	0000	0.15	0.00	00.00	00.097	20.48	1.05	1.00	0.95	000.000	00.000
18.30	012	095	161	00.52	0.36	0000	0000	0.15	0.00	00.00	00.097	20.49	1.05	1.01	0.94	000.000	00.000
19.00	012	093	155	00.52	0.37	0000	0000	0.14	0.00	00.00	00.095	20.50	1.03	1.01	0.93	000.000	00.000
19.30	012	091	150	00.51	0.37	0000	0000	0.13	0.00	00.00	00.094	20.54	1.06	0.98	0.92	000.000	00.000
20.00	012	088	145	00.50	0.38	0000	0000	0.13	0.00	00.00	00.092	20.56	1.09	0.77	0.94	000.000	00.000

TABLE 9: Small cribs - 4 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	022	037	00.20	00.0	0000	0000	0.08	0.00	00.00	00.000	21.43	0.00	0.00	0.00	000.000	00.000
00.30	010	029	060	00.23	00.5	0000	0000	0.08	0.00	00.00	00.000	21.37	0.00	0.00	0.00	000.000	00.000
01.00	010	037	073	00.34	00.3	0000	0000	0.09	0.00	00.00	00.000	21.40	0.00	0.00	0.00	000.000	00.000
01.30	010	049	114	00.34	00.3	0000	0000	0.10	0.00	00.17	00.000	21.25	0.00	0.00	0.00	000.000	00.000
02.00	010	063	158	00.39	00.4	0000	0000	0.11	0.00	00.46	00.000	20.74	0.00	0.00	0.00	000.000	00.000
02.30	010	081	209	00.49	00.2	0000	0000	0.13	0.00	00.93	00.091	20.47	0.00	0.00	0.00	000.000	00.000
03.00	010	107	311	00.54	00.6	0001	0000	0.15	0.00	01.37	00.093	20.01	0.00	0.00	0.00	000.000	00.000
03.30	010	127	349	00.63	00.8	0001	0000	0.19	0.00	01.76	00.095	19.80	0.00	0.00	0.00	000.000	00.000
04.00	010	146	392	00.64	00.7	0001	0000	0.24	0.00	02.82	00.096	19.13	0.00	0.00	0.00	000.000	00.000
04.30	010	172	464	00.76	01.0	0002	0000	0.33	0.00	03.40	00.100	18.37	0.00	0.00	0.00	000.000	00.000
05.00	009	201	524	00.77	03.3	0004	0001	0.47	0.00	03.36	00.099	18.45	0.00	0.00	0.00	000.000	00.000
05.30	010	207	555	00.86	02.1	0005	0001	0.52	0.00	04.55	00.099	17.46	0.00	0.00	0.00	000.000	00.000
06.00	009	215	544	00.99	03.0	0007	0004	0.54	0.00	05.36	00.102	16.38	0.00	0.00	0.00	000.000	00.000
06.30	009	210	460	00.84	02.2	0005	0008	0.54	0.00	06.47	00.105	15.72	0.00	0.00	0.00	000.000	00.000
07.00	009	201	411	00.87	02.5	0006	0011	0.49	0.00	05.73	00.107	15.10	0.00	0.00	0.00	000.000	00.000
07.30	009	191	337	00.88	01.2	0003	0012	0.42	0.00	05.21	00.108	15.20	0.00	0.00	0.00	000.000	00.000
08.00	009	166	268	00.83	00.5	0001	0012	0.34	0.00	04.27	00.108	16.44	0.00	0.00	0.00	000.000	00.000
08.30	009	139	220	00.78	00.0	0000	0012	0.29	0.00	03.20	00.112	16.25	0.00	0.00	0.00	000.000	00.000
09.00	009	123	210	00.77	00.0	0000	0012	0.25	0.00	02.30	00.120	17.58	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	026	042	00.00	00.0	0000	0000	0.09	0.00	00.00	00.000	21.21	0.00	0.00	0.00	000.000	00.000
00.30	010	033	063	00.24	00.2	0000	0000	0.09	0.00	00.00	00.000	20.77	0.00	0.00	0.00	000.000	00.000
01.00	010	043	095	00.28	00.1	0000	0000	0.10	0.00	00.00	00.000	21.12	0.00	0.00	0.00	000.000	00.000
01.30	009	061	145	00.34	00.1	0000	0000	0.10	0.00	00.35	00.000	20.36	0.00	0.00	0.00	000.000	00.000
02.00	009	077	193	00.50	00.1	0000	0000	0.13	0.00	00.87	00.000	20.58	0.00	0.00	0.00	000.000	00.000
02.30	009	101	284	00.56	00.3	0000	0000	0.17	0.00	01.44	00.149	20.37	0.00	0.00	0.00	000.000	00.000
03.00	009	128	349	00.60	00.5	0001	0000	0.21	0.00	02.02	00.153	19.73	0.00	0.00	0.00	000.000	00.000
03.30	009	146	377	00.67	00.7	0001	0000	0.26	0.00	03.03	00.153	19.06	0.00	0.00	0.00	000.000	00.000
04.00	009	175	485	00.74	00.8	0001	0000	0.37	0.00	03.52	00.158	18.06	0.00	0.00	0.00	000.000	00.000
04.30	008	189	550	00.81	01.0	0004	0000	0.54	0.00	04.35	00.163	17.48	0.00	0.00	0.00	000.000	00.000
05.00	009	198	557	00.89	01.7	0004	0001	0.62	0.00	05.30	00.165	16.53	0.00	0.00	0.00	000.000	00.000
05.30	009	208	536	00.95	02.7	0007	0002	0.61	0.00	06.07	00.168	15.82	0.00	0.00	0.00	000.000	00.000
06.00	009	204	490	00.86	03.1	0007	0004	0.52	0.00	06.65	00.171	14.79	0.00	0.00	0.00	000.000	00.000
06.30	009	196	441	00.74	02.3	0006	0007	0.51	0.00	06.33	00.167	14.84	0.00	0.00	0.00	000.000	00.000
07.00	009	185	368	00.88	01.7	0004	0009	0.44	0.00	05.81	00.176	14.37	0.00	0.00	0.00	000.000	00.000
07.30	010	165	278	00.91	00.7	0002	0009	0.40	0.00	04.83	00.181	15.54	0.00	0.00	0.00	000.000	00.000
08.00	008	138	234	00.96	00.2	0000	0009	0.33	0.00	03.63	00.187	16.13	0.00	0.00	0.00	000.000	00.000
08.30	009	125	222	00.83	00.1	0000	0009	0.28	0.00	02.48	00.194	17.11	0.00	0.00	0.00	000.000	00.000
09.00	009	114	210	00.79	00.1	0000	0009	0.27	0.00	01.89	00.215	18.17	0.00	0.00	0.00	000.000	00.000
09.30	010	108	207	00.82	00.1	0000	0009	0.24	0.00	01.57	00.235	19.26	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	014	024	00.00	00.0	0000	0000	0.06	0.00	00.00	00.000	21.29	0.00	0.00	0.00	000.000	00.000
00.30	010	019	046	00.16	00.0	0000	0000	0.07	0.00	00.00	00.000	20.92	0.00	0.00	0.00	000.000	00.000
01.00	010	029	078	00.26	00.3	0000	0000	0.08	0.00	00.00	00.000	20.90	0.00	0.00	0.00	000.000	00.000
01.30	010	044	128	00.30	00.3	0000	0000	0.09	0.00	00.21	00.076	21.33	0.00	0.00	0.00	000.000	00.000
02.00	010	064	191	00.40	00.4	0000	0000	0.10	0.00	00.66	00.081	20.79	0.00	0.00	0.00	000.000	00.000
02.30	010	082	249	00.45	00.3	0000	0000	0.13	0.00	01.29	00.082	20.31	0.00	0.00	0.00	000.000	00.000
03.00	010	103	292	00.55	00.7	0001	0000	0.16	0.00	01.74	00.082	19.77	0.00	0.00	0.00	000.000	00.000
03.30	010	122	321	00.65	00.9	0001	0000	0.29	0.00	02.33	00.085	19.52	0.00	0.00	0.00	000.000	00.000
04.00	010	144	345	00.74	01.1	0002	0000	0.31	0.00	02.78	00.085	19.19	0.00	0.00	0.00	000.000	00.000
04.30	010	162	383	00.81	01.5	0003	0000	0.33	0.00	03.29	00.092	18.51	0.00	0.00	0.00	000.000	00.000
05.00	010	183	474	00.78	01.7	0003	0000	0.41	0.00	03.03	00.092	17.70	0.00	0.00	0.00	000.000	00.000
05.30	010	192	644	00.86	01.7	0004	0000	0.42	0.00	04.19	00.090	17.57	0.00	0.00	0.00	000.000	00.000
06.00	010	199	598	00.87	01.2	0003	0000	0.47	0.00	04.24	00.094	16.73	0.00	0.00	0.00	000.000	00.000
06.30	010	201	562	00.95	01.2	0003	0000	0.49	0.00	04.30	00.096	16.29	0.00	0.00	0.00	000.000	00.000
07.00	010	205	423	00.96	02.2	0005	0000	0.48	0.00	05.03	00.088	16.36	0.00	0.00	0.00	000.000	00.000
07.30	010	201	399	01.08	02.2	0006	0002	0.48	0.00	05.13	00.091	15.76	0.00	0.00	0.00	000.000	00.000
08.00	010	188	341	00.88	02.0	0004	0006	0.47	0.00	05.20	00.100	16.02	0.00	0.00	0.00	000.000	00.000
08.30	010	167	268	00.85	01.3	0003	0008	0.39	0.00	04.73	00.102	15.98	0.00	0.00	0.00	000.000	00.000
09.00	010	134	205	00.86	01.3	0002	0009	0.29	0.00	03.98	00.102	16.76	0.00	0.00	0.00	000.000	00.000
09.30	010	117	196	00.81	01.1	0002	0009	0.25	0.00	02.70	00.108	17.45	0.00	0.00	0.00	000.000	00.000
10.00	010	107	199	00.73	01.1	0002	0009	0.23	0.00	01.79	00.117	18.01	0.00	0.00	0.00	000.000	00.000

TABLE 10: Small crib - 4 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	012	021	043	00.00	00.0	0000	0000	0.13	0.00	00.00	00.000	23.42	0.00	0.00	0.00	000.000	00.000
00.30	012	028	094	00.18	00.3	0000	0000	0.14	0.00	00.00	00.000	22.72	0.00	0.00	0.00	000.000	00.000
01.00	012	037	139	00.27	00.1	0000	0000	0.15	0.00	00.00	00.000	22.33	0.00	0.00	0.00	000.000	00.000
01.30	012	053	199	00.37	00.0	0000	0000	0.17	0.00	00.29	00.104	22.13	0.00	0.00	0.00	000.000	00.000
02.00	011	073	293	00.38	00.1	0000	0000	0.21	0.00	00.35	00.112	22.53	0.00	0.00	0.00	000.000	00.000
02.30	012	107	371	00.55	00.3	0000	0000	0.27	0.00	01.15	00.114	22.22	0.00	0.00	0.00	000.000	00.000
03.00	011	141	521	00.52	01.6	0002	0000	0.35	0.00	01.37	00.129	21.55	0.00	0.00	0.00	000.000	00.000
03.30	012	167	622	00.57	03.1	0005	0000	0.44	0.00	02.31	00.128	20.47	0.00	0.00	0.00	000.000	00.000
04.00	011	173	686	00.71	08.2	0014	0004	0.55	0.00	04.24	00.123	17.44	0.00	0.00	0.00	000.000	00.000
04.30	011	173	723	00.81	29.7	0059	0023	0.59	0.00	05.33	00.122	18.19	0.00	0.00	0.00	000.000	00.000
05.00	011	179	747	00.39	17.7	0033	0033	0.57	0.00	07.33	00.137	16.21	0.00	0.00	0.00	000.000	00.000
05.30	011	189	693	00.32	09.2	0019	0044	0.59	0.00	09.00	00.235	14.34	0.00	0.00	0.00	000.000	00.000
06.00	011	185	617	00.33	04.3	0000	0052	0.55	0.00	07.15	00.207	13.53	0.00	0.00	0.00	000.000	00.000
06.30	011	179	502	00.77	01.2	0002	0055	0.47	0.00	05.75	00.155	14.63	0.00	0.00	0.00	000.000	00.000
07.00	011	161	401	00.74	00.1	0000	0055	0.39	0.00	04.35	00.179	15.30	0.00	0.00	0.00	000.000	00.000
07.30	011	151	371	00.73	00.1	0000	0055	0.35	0.00	02.55	00.132	17.59	0.00	0.00	0.00	000.000	00.000
08.00	011	141	353	00.72	00.2	0000	0055	0.33	0.00	01.73	00.155	19.12	0.00	0.00	0.00	000.000	00.000
08.30	011	134	317	00.62	00.3	0000	0055	0.32	0.00	01.42	00.166	20.33	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	014	019	00.00	00.0	0000	0000	0.13	0.00	00.00	00.000	21.18	0.00	0.00	0.00	000.000	00.000
00.30	010	014	057	00.21	00.5	0000	0000	0.12	0.00	00.00	00.000	21.18	0.00	0.00	0.00	000.000	00.000
01.00	009	024	100	00.13	00.0	0000	0000	0.13	0.00	00.00	00.000	21.19	0.00	0.00	0.00	000.000	00.000
01.30	009	051	231	00.31	00.0	0000	0000	0.12	0.00	00.00	00.141	21.26	0.00	0.00	0.00	000.000	00.000
02.00	010	087	373	00.42	00.0	0000	0000	0.25	0.00	00.00	00.177	21.13	0.00	0.00	0.00	000.000	00.000
02.30	009	134	533	00.47	00.0	0000	0000	0.33	0.00	01.74	00.196	20.77	0.00	0.00	0.00	000.000	00.000
03.00	009	145	703	00.55	02.1	0003	0000	0.46	0.00	03.14	00.180	19.40	0.00	0.00	0.00	000.000	00.000
03.30	010	150	791	00.63	07.0	0010	0004	0.53	0.00	04.24	00.133	18.34	0.00	0.00	0.00	000.000	00.000
04.00	009	160	814	00.70	14.8	0024	0015	0.61	0.00	06.81	00.165	17.45	0.00	0.00	0.00	000.000	00.000
04.30	009	169	933	00.69	12.2	0019	0027	0.65	0.00	07.21	00.225	15.35	0.00	0.00	0.00	000.000	00.000
05.00	009	182	829	00.73	19.7	0019	0037	0.67	0.00	04.15	00.277	14.30	0.00	0.00	0.00	000.000	00.000
05.30	009	186	726	00.66	07.5	0012	0046	0.57	0.00	03.73	00.217	16.74	0.00	0.00	0.00	000.000	00.000
06.00	009	193	593	00.60	03.3	0004	0051	0.51	0.00	03.47	00.183	17.45	0.00	0.00	0.00	000.000	00.000
06.30	009	195	509	00.53	01.3	0002	0051	0.46	0.00	02.36	00.164	17.37	0.00	0.00	0.00	000.000	00.000
07.00	009	174	427	00.64	00.0	0000	0051	0.40	0.00	01.78	00.162	18.16	0.00	0.00	0.00	000.000	00.000
07.30	009	148	392	00.63	00.0	0000	0051	0.36	0.00	01.51	00.165	19.15	0.00	0.00	0.00	000.000	00.000
08.00	009	113	339	00.54	00.0	0000	0051	0.33	0.00	01.41	00.173	19.44	0.00	0.00	0.00	000.000	00.000
08.30	009	139	337	00.55	00.0	0000	0051	0.31	0.00	00.72	00.199	19.55	0.00	0.00	0.00	000.000	00.000
09.00	009	124	319	00.57	00.0	0000	0051	0.30	0.00	00.56	00.214	20.36	0.00	0.00	0.00	000.000	00.000

TABLE 10: Small crib - 2 m corridor - 10 cm opening (cont.)

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	005	019	00.00	00.0	0000	0000	0.06	0.00	00.00	00.000	20.01	0.00	0.00	0.00	000.000	00.000
00.30	011	009	043	00.00	00.2	0000	0000	0.07	0.00	00.00	00.000	19.85	0.00	0.00	0.00	000.000	00.000
01.00	011	029	068	00.18	02.3	0001	0000	0.09	0.00	00.15	00.000	19.87	0.00	0.00	0.00	000.000	00.000
01.30	011	034	104	00.27	03.4	0001	0000	0.13	0.00	00.29	00.000	19.45	0.00	0.00	0.00	000.000	00.000
02.00	011	062	145	00.36	03.1	0002	0000	0.06	0.00	01.19	00.159	19.13	0.00	0.00	0.00	000.000	00.000
02.30	011	104	181	00.34	03.2	0003	0001	0.07	0.00	01.75	00.151	18.83	0.00	0.00	0.00	000.000	00.000
03.00	011	151	229	00.55	03.4	0004	0001	0.09	0.00	02.34	00.151	17.86	0.00	0.00	0.00	000.000	00.000
03.30	011	219	315	00.23	03.7	0007	0003	0.13	0.00	04.11	00.151	17.00	0.00	0.00	0.00	000.000	00.000
04.00	011	273	466	00.69	04.7	0019	0009	0.13	0.00	05.76	00.142	15.71	0.00	0.00	0.00	000.000	00.000
04.30	011	285	555	00.71	17.4	0038	0023	0.25	0.00	07.41	00.145	14.22	0.00	0.00	0.00	000.000	00.000
05.00	011	312	617	00.76	20.4	0056	0045	0.39	0.00	09.03	00.262	12.42	0.00	0.00	0.00	000.000	00.000
05.30	011	319	672	00.77	19.7	0040	0063	0.35	0.00	08.63	00.242	11.07	0.00	0.00	0.00	000.000	00.000
06.00	011	316	639	00.75	09.1	0022	0083	0.34	0.00	08.09	00.537	11.33	0.00	0.00	0.00	000.000	00.000
06.30	011	284	517	00.79	04.3	0011	0000	0.27	0.00	06.51	00.191	12.09	0.00	0.00	0.00	000.000	00.000
07.00	011	236	432	00.63	02.3	0008	0005	0.21	0.00	03.77	00.142	13.79	0.00	0.00	0.00	000.000	00.000
07.30	011	201	366	00.56	02.5	0004	0004	0.19	0.00	02.21	00.172	16.31	0.00	0.00	0.00	000.000	00.000
08.00	011	181	323	00.59	02.9	0004	0005	0.16	0.00	01.59	00.218	17.76	0.00	0.00	0.00	000.000	00.000
08.30	012	153	298	00.52	02.7	0004	0004	0.14	0.00	01.43	00.237	18.25	0.00	0.00	0.00	000.000	00.000
09.00	012	156	254	00.52	02.3	0003	0006	0.13	0.00	01.32	00.197	18.83	0.00	0.00	0.00	000.000	00.000
09.30	012	148	233	00.57	03.0	0004	0006	0.13	0.00	01.21	00.192	18.85	0.00	0.00	0.00	000.000	00.000
10.00	012	141	233	00.57	02.7	0004	0004	0.12	0.00	01.37	00.173	18.76	0.00	0.00	0.00	000.000	00.000
10.30	012	135	213	00.54	02.6	0003	0004	0.12	0.00	00.78	00.157	18.90	0.00	0.00	0.00	000.000	00.000
11.00	012	129	202	00.55	02.7	0004	0004	0.11	0.00	00.85	00.164	19.02	0.00	0.00	0.00	000.000	00.000
11.30	012	124	192	00.53	02.3	0003	0004	0.11	0.00	00.73	00.155	19.17	0.00	0.00	0.00	000.000	00.000
12.00	012	119	186	00.55	02.7	0003	0004	0.10	0.00	00.67	00.150	19.30	0.00	0.00	0.00	000.000	00.000
12.30	012	115	160	00.52	02.7	0003	0004	0.10	0.00	00.53	00.145	19.34	0.00	0.00	0.00	000.000	00.000
13.00	012	110	177	00.52	03.2	0004	0004	0.10	0.00	00.54	00.133	19.44	0.00	0.00	0.00	000.000	00.000
13.30	012	105	170	00.52	02.3	0003	0004	0.10	0.00	00.49	00.128	19.49	0.00	0.00	0.00	000.000	00.000
14.00	012	102	166	00.51	02.7	0003	0004	0.10	0.00	00.42	00.125	19.55	0.00	0.00	0.00	000.000	00.000
14.30	012	098	160	00.50	03.0	0003	0004	0.09	0.00	00.37	00.126	19.54	0.00	0.00	0.00	000.000	00.000
15.00	012	095	155	00.52	02.9	0003	0004	0.08	0.00	00.32	00.120	19.67	0.00	0.00	0.00	000.000	00.000
15.30	012	092	149	00.54	03.1	0003	0004	0.09	0.00	00.27	00.119	19.70	0.00	0.00	0.00	000.000	00.000
16.00	012	089	146	00.53	03.1	0003	0004	0.09	0.00	00.22	00.117	19.71	0.00	0.00	0.00	000.000	00.000
16.30	012	086	140	00.50	03.4	0003	0004	0.09	0.00	00.19	00.116	19.31	0.00	0.00	0.00	000.000	00.000
17.00	012	083	134	00.47	02.7	0003	0004	0.08	0.00	00.16	00.114	19.83	0.00	0.00	0.00	000.000	00.000
17.30	012	081	132	00.52	03.4	0003	0004	0.09	0.00	00.12	00.111	19.83	0.00	0.00	0.00	000.000	00.000
18.00	012	079	127	00.51	02.9	0003	0004	0.09	0.00	00.07	00.109	19.71	0.00	0.00	0.00	000.000	00.000
18.30	012	076	124	00.47	02.9	0003	0006	0.08	0.00	00.06	00.109	19.75	0.00	0.00	0.00	000.000	00.000
19.00	012	074	122	00.54	02.3	0003	0006	0.08	0.00	00.04	00.110	19.77	0.00	0.00	0.00	000.000	00.000
19.30	012	072	119	00.46	02.3	0002	0004	0.08	0.00	00.02	00.111	19.71	0.00	0.00	0.00	000.000	00.000
20.00		069	115	00.48	03.2	0003	0006	0.08	0.00	00.01	00.139	19.76	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	018	023	00.00	00.0	0000	0000	0.06	0.00	00.00	00.000	20.23	0.00	0.00	0.00	000.000	00.000
00.30	013	024	056	00.15	00.1	0000	0000	0.06	0.00	00.00	00.000	20.21	0.00	0.00	0.00	000.000	00.000
01.00	013	045	111	00.26	00.2	0000	0000	0.06	0.00	00.27	00.000	20.26	0.00	0.00	0.00	000.000	00.000
01.30	013	080	166	00.46	00.1	0000	0000	0.07	0.00	01.00	00.029	19.70	0.00	0.00	0.00	000.000	00.000
02.00	013	129	273	00.55	00.5	0001	0000	0.11	0.00	02.44	00.087	19.23	0.00	0.00	0.00	000.000	00.000
02.30	013	182	367	00.67	01.6	0003	0000	0.15	0.00	03.23	00.100	18.24	0.00	0.00	0.00	000.000	00.000
03.00	013	227	566	00.71	03.3	0006	0001	0.21	0.00	05.12	00.076	17.01	0.00	0.00	0.00	000.000	00.000
03.30	013	241	643	00.71	11.4	0022	0007	0.32	0.00	07.33	00.105	15.72	0.00	0.00	0.00	000.000	00.000
04.00	013	277	719	00.77	08.7	0029	0024	0.54	0.00	09.29	00.223	13.73	0.00	0.00	0.00	000.000	00.000
04.30	013	272	826	00.74	27.6	0041	0045	0.75	0.00	09.43	00.336	11.74	0.00	0.00	0.00	000.000	00.000
05.00	013	272	732	00.76	11.7	0027	0066	1.00	0.00	09.03	00.227	11.71	0.00	0.00	0.00	000.000	00.000
05.30	013	274	713	00.72	04.7	0011	0077	0.30	0.00	08.17	00.235	12.44	0.00	0.00	0.00	000.000	00.000
06.00	013	281	629	00.75	04.4	0019	0083	0.57	0.00	06.23	00.124	13.36	0.00	0.00	0.00	000.000	00.000
06.30	013	233	522	00.72	01.2	0002	0084	0.41	0.00	04.37	00.110	14.75	0.00	0.00	0.00	000.000	00.000
07.00	013	208	455	00.71	00.2	0000	0084	0.34	0.00	02.73	00.140	16.75	0.00	0.00	0.00	000.000	00.000
07.30	013	190	410	00.67	00.5	0001	0084	0.33	0.00	02.07	00.166	17.35	0.00	0.00	0.00	000.000	00.000
08.00	013	170	382	00.65	00.3	0000	0084	0.27	0.00	01.75	00.159	18.03	0.00	0.00	0.00	000.000	00.000
08.30	013	167	351	00.62	00.2	0000	0084	0.23	0.00	01.48	00.239	18.72	0.00	0.00	0.00	000.000	00.000
09.00	013	161	327	00.61	00.3	0000	0084	0.20	0.00	01.33	00.214	18.93	0.00	0.00	0.00	000.000	00.000
09.30	013	155	309	00.53	00.4	0001	0084	0.17	0.00	01.17	00.199	19.23	0.00	0.00	0.00	000.000	00.000
10.00	013	145	290	00.57	00.4	0001	0084	0.15	0.00	01.06	00.196	19.27	0.00	0.00	0.00	000.000	00.000
10.30	013	138	276	00.59	00.3	0000	0084	0.14	0.00	00.87	00.170	19.17	0.00	0.00	0.00	000.000	00.000
11.00	013	133	229	00.56	00.4	0000	0084	0.12	0.00	00.74	00.147	19.36	0.00	0.00	0.00	000.000	00.000
11.30	013	128	227	00.59	00.3	0000	0084	0.13	0.00	00.62	00.140	19.71	0.00	0.00	0.00	000.000	00.000
12.00	013	123	214	00.54	00.2	0000	0084	0.10	0.00	00.53	00.134	19.57	0.00	0.00	0.00	000.000	00.000
12.30	013	118	203	00.55	00.2	0000	0084	0.09	0.00	00.45	00.125	19.73	0.00	0.00	0.00	000.000	00.000

TABLE 11: Medium crib - free burning.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	001.195	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	001.192	00.000
01.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	001.192	00.000
01.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	001.185	00.000
02.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	001.174	00.000
02.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	001.167	00.000
03.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.01	0.01	001.156	00.000
03.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.02	0.03	001.135	00.000
04.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.02	0.03	0.04	001.121	00.000
04.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.03	0.05	0.07	001.093	00.000
05.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.04	0.07	0.07	001.058	00.000
05.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.05	0.08	0.10	001.012	00.000
06.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.07	0.11	0.12	000.963	00.000
06.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.09	0.15	0.15	000.914	00.000
07.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.10	0.18	0.17	000.851	00.000
07.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.14	0.23	0.22	000.794	00.000
08.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.16	0.29	0.27	000.717	00.000
08.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.18	0.34	0.33	000.654	00.000
09.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.23	0.41	0.38	000.584	00.000
09.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.24	0.47	0.44	000.524	00.000
10.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.28	0.53	0.50	000.468	00.000
10.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.36	0.58	0.55	000.411	00.000
11.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.64	0.56	000.362	00.000
11.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.49	0.66	0.62	000.323	00.000
12.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.72	0.62	000.298	00.000
12.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.50	0.79	0.67	000.253	00.000
13.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.50	0.79	0.67	000.225	00.000
13.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.55	0.92	0.69	000.204	00.000
14.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.53	0.89	0.69	000.179	00.000
14.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.55	0.82	0.70	000.165	00.000
15.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.51	0.80	0.69	000.155	00.000
15.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.50	0.85	0.71	000.141	00.000
16.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.53	0.82	0.71	000.127	00.000
16.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.53	0.80	0.72	000.113	00.000
17.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.49	0.89	0.75	000.109	00.000
17.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.50	0.89	0.73	000.102	00.000
18.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.54	0.83	0.73	000.095	00.000
18.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.54	0.82	0.73	000.095	00.000
19.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.55	0.81	0.71	000.091	00.000
19.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.55	0.81	0.70	000.084	00.000
20.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.55	0.79	0.69	000.081	00.000

TABLE 12: Medium crib - box only - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	003	023	00.00	0.00	0000	0000	0.11	0.00	00.00	00.000	20.47	0.00	0.00	0.00	001.184	00.000
00.30	009	002	046	00.00	0.00	0000	0000	0.12	0.00	00.00	00.000	20.45	0.00	0.00	0.00	001.182	00.000
01.00	009	002	067	00.00	0.00	0000	0000	0.15	0.00	00.14	00.000	20.57	0.00	0.00	0.00	001.117	00.000
01.30	009	002	093	00.00	0.00	0000	0000	0.12	0.00	00.22	00.000	20.47	0.00	0.02	0.00	001.189	00.000
02.00	010	002	117	00.00	0.00	0000	0000	0.23	0.00	00.75	00.000	20.75	0.00	0.01	0.00	001.185	00.000
02.30	010	002	122	00.00	0.00	0000	0000	0.21	0.00	00.51	00.000	20.29	0.00	0.00	0.00	001.182	00.000
03.00	010	002	150	00.00	0.00	0000	0000	0.25	0.00	00.88	00.000	20.13	0.00	0.01	0.00	001.182	00.000
03.30	010	002	185	00.00	0.00	0000	0000	0.37	0.00	01.10	00.000	19.77	0.00	0.00	0.01	001.155	00.000
04.00	010	002	279	00.00	0.00	0000	0000	0.51	0.00	01.48	00.078	19.63	0.00	0.00	0.01	001.051	00.000
04.30	010	002	335	00.00	0.00	0000	0000	0.75	0.00	02.41	00.020	19.20	0.00	0.07	0.03	001.031	00.000
05.00	010	003	440	00.00	0.00	0000	0000	1.06	0.00	03.25	00.095	18.00	0.02	0.04	0.04	000.951	00.000
05.30	010	003	560	00.00	0.00	0000	0000	1.56	0.00	04.27	00.113	17.25	0.01	0.06	0.07	000.917	00.000
06.00	010	003	674	00.00	0.00	0000	0000	2.26	0.00	06.41	00.110	15.76	0.03	0.08	0.10	000.855	00.000
06.30	010	003	696	00.00	0.00	0000	0000	2.56	0.00	08.77	00.109	13.57	0.05	0.13	0.13	000.757	00.000
07.00	010	003	697	00.00	0.00	0000	0000	3.10	0.00	08.54	00.113	12.47	0.07	0.22	0.12	000.717	00.000
07.30	010	004	774	00.00	0.00	0000	0000	3.17	0.00	08.83	00.117	12.19	0.17	0.30	0.33	000.543	00.000
08.00	010	004	779	00.00	0.00	0000	0000	3.32	0.00	11.71	00.114	10.27	0.45	0.51	0.56	000.455	00.000
08.30	010	005	738	00.00	0.00	0000	0000	3.14	0.00	11.22	00.287	10.20	0.54	0.73	0.74	000.325	00.000
09.00	010	005	677	00.00	0.00	0000	0000	3.37	0.00	09.78	00.313	10.41	0.58	0.74	0.76	000.310	00.000
09.30	010	005	648	00.00	0.00	0000	0000	3.38	0.00	08.49	00.485	11.75	0.71	0.90	1.03	000.223	00.000
10.00	010	005	563	00.00	0.00	0000	0000	3.24	0.00	07.77	00.281	12.62	0.71	1.09	1.09	000.180	00.000
10.30	011	004	515	00.00	0.00	0000	0000	3.00	0.00	06.23	00.131	13.74	0.79	1.22	1.19	000.125	00.000
11.00	011	005	375	00.00	0.00	0000	0000	2.35	0.00	04.76	00.103	14.79	0.80	1.22	1.18	000.102	00.000
11.30	011	005	317	00.00	0.00	0000	0000	1.76	0.00	02.90	00.121	16.75	0.84	1.23	1.21	000.102	00.000
12.00	011	004	263	00.00	0.00	0000	0000	1.77	0.00	02.35	00.143	17.59	0.85	1.27	1.14	000.085	00.000
12.30	011	004	224	00.00	0.00	0000	0000	1.53	0.00	02.14	00.160	18.46	0.77	1.20	1.09	000.075	00.000
13.00	011	004	219	00.00	0.00	0000	0000	1.55	0.00	01.88	00.155	18.67	0.76	1.17	1.05	000.067	00.000
13.30	011	004	177	00.00	0.00	0000	0000	1.46	0.00	01.22	00.158	18.86	0.74	1.16	1.04	000.055	00.000
14.00	011	004	199	00.00	0.00	0000	0000	1.37	0.00	01.69	00.146	18.87	0.77	1.16	1.03	000.047	00.000
14.30	011	004	165	00.00	0.00	0000	0000	1.30	0.00	01.79	00.136	18.74	0.84	1.15	1.03	000.031	00.000
15.00	011	004	158	00.00	0.00	0000	0000	1.23	0.00	01.67	00.174	18.79	0.73	1.15	1.01	000.023	00.000
15.30	011	004	134	00.00	0.00	0000	0000	1.17	0.00	01.67	00.125	18.77	0.73	1.15	0.90	000.015	00.000
16.00	011	004	152	00.00	0.00	0000	0000	1.07	0.00	01.53	00.124	19.06	0.75	1.12	0.92	000.004	00.000
16.30	011	004	144	00.00	0.00	0000	0000	0.97	0.00	01.44	00.122	19.24	0.80	1.12	0.96	000.000	00.000
17.00	011	004	148	00.00	0.00	0000	0000	0.91	0.00	01.42	00.120	19.29	0.73	1.11	0.96	000.000	00.000
17.30	011	004	137	00.00	0.00	0000	0000	0.86	0.00	01.42	00.119	19.32	0.79	1.10	0.96	000.000	00.000
18.00	011	004	123	00.00	0.00	0000	0000	0.76	0.00	01.34	00.115	19.33	0.76	1.10	0.96	000.000	00.000
18.30	011	004	112	00.00	0.00	0000	0000	0.73	0.00	01.27	00.109	19.43	0.76	1.11	0.96	000.000	00.000
19.00	011	004	116	00.00	0.00	0000	0000	0.67	0.00	01.17	00.111	19.52	0.77	1.09	0.96	000.000	00.000
19.30	011	004	113	00.00	0.00	0000	0000	0.62	0.00	01.11	00.110	19.58	0.76	1.09	0.95	000.000	00.000
20.00	011	004	125	00.00	0.00	0000	0000	0.55	0.00	01.09	00.107	19.51	0.76	1.07	0.94	000.000	00.000

TABLE 13: Medium crib - box only - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	001	024	00.00	0.00	0000	0000	0.09	0.00	00.00	00.057	21.63	0.00	0.00	0.00	001.201	00.000
00.30	011	001	074	00.00	0.00	0000	0000	0.07	0.00	00.09	00.095	21.57	0.00	0.00	0.00	001.226	00.000
01.00	011	001	096	00.00	0.00	0000	0000	0.10	0.00	00.46	00.111	20.75	0.00	0.00	0.00	001.222	00.000
01.30	011	001	147	00.00	0.00	0000	0000	0.12	0.00	00.71	00.124	20.62	0.00	0.00	0.00	001.225	00.000
02.00	011	001	235	00.00	0.00	0000	0000	0.10	0.00	01.21	00.122	20.25	0.00	0.00	0.00	001.230	00.000
02.30	011	001	357	00.00	0.00	0000	0000	0.13	0.00	02.23	00.129	19.54	0.01	0.01	0.01	001.197	00.000
03.00	011	001	554	00.00	0.00	0000	0000	0.18	0.00	03.63	00.134	18.13	0.02	0.01	0.02	001.174	00.000
03.30	011	001	759	00.00	0.00	0000	0000	0.31	0.00	05.31	00.147	16.29	0.04	0.02	0.04	001.135	00.000
04.00	011	001	890	00.00	0.00	0000	0000	0.38	0.00	09.52	00.753	12.91	0.12	0.12	0.19	001.064	00.000
04.30	011	001	821	00.00	0.00	0000	0000	0.52	0.00	14.26	01.065	07.24	0.31	0.31	0.34	001.010	00.000
05.00	011	002	715	00.00	0.00	0000	0000	0.87	0.00	15.49	01.741	02.34	0.48	0.55	0.59	000.930	00.000
05.30	011	002	718	00.00	0.00	0000	0000	1.32	0.00	16.31	02.241	01.57	0.24	0.24	0.32	000.789	00.000
06.00	011	003	732	00.00	0.00	0000	0000	1.72	0.00	15.24	03.371	01.54	0.90	1.00	0.50	000.603	00.000
06.30	011	003	758	00.00	0.00	0000	0000	2.14	0.00	07.22	04.269	05.32	1.26	1.17	1.14	000.538	00.000
07.00	011	003	769	00.00	0.00	0000	0000	2.70	0.00	05.36	04.379	12.47	1.29	1.44	1.42	000.41	00.000
07.30	011	004	776	00.00	0.00	0000	0000	3.32	0.00	05.20	04.145	14.11	1.36	1.77	1.67	000.777	00.000
08.00	011	004	822	00.00	0.00	0000	0000	3.30	0.00	05.62	04.548	13.76	1.71	2.17	2.14	000.129	00.000
08.30	012	004	846	00.00	0.00	0000	0000	3.22	0.00	06.35	04.712	12.55	2.14	2.63	2.59	000.137	00.000
09.00	012	004	852	00.00	0.00	0000	0000	3.06	0.00	06.50	03.750	11.06	2.47	3.21	2.73	000.494	00.000
09.30	012	004	900	00.00	0.00	0000	0000	3.16	0.00	07.45	01.691	11.46	2.79	3.17	3.25	000.479	00.000
10.00	012	003	803	00.00	0.00	0000	0000	4.12	0.00	07.27	00.339	11.95	2.49	3.29	3.01	000.447	00.000
10.30	012	003	748	00.00	0.00	0000	0000	4.18	0.00	05.33	00.141	12.23	2.24	2.92	2.71	000.435	00.000
11.00	012	003	715	00.00	0.00	0000	0000	3.92	0.00	04.25	00.144	15.25	2.24	2.76	2.55	000.27	00.000
11.30	012	003	669	00.00	0.00	0000	0000	3.45	0.00	03.74	00.183	16.25	2.20	2.68	2.49	000.000	00.000
12.00	012	003	567	00.00	0.00	0000	0000	3.16	0.00	03.42	00.234	16.83	2.21	2.73	2.39	000.000	00.000
12.30	012	003	543	00.00	0.00	0000	0000	2.99	0.00	01.97	00.248	15.34	2.15	2.67	2.44	000.000	00.000
13.00	012	003	529	00.00	0.00	0000	0000	2.70	0.00	01.83	00.271	18.77	2.15	2.67	2.53	000.000	00.000
13.30	012	003	466	00.00	0.00	0000	0000	2.16	0.00	01.31	00.231	18.36	2.21	2.71	2.53	000.000	00.000
14.00	012	003	449	00.00	0.00	0000	0000	2.12	0.00	01.50	00.236	19.01	2.17	2.79	2.52	000.000	00.000
14.30	012	003	437	00.00	0.00	0000	0000	1.92	0.00	01.48	00.244	19.30	2.15	2.79	2.44	000.000	00.000
15.00	012	003	407	00.00	0.00	0000	0000	1.67	0.00	01.29	00.22	19.39	2.16	2.59	2.47	000.000	00.000
15.30	012	003	392	00.00	0.00	0000	0000	1.58	0.00	01.33	00.229	19.49	2.18	2.62	2.47	000.000	00.000
16.00	012	003	384	00.00	0.00	0000	0000	1.54	0.00	01.20	00.212	19.53	2.17	2.57	2.41	000.000	00.000
16.30	012	003	370	00.00	0.00	0000	0000	1.52	0.00	01.15	00.216	19.55	2.24	2.63	2.43	000.000	00.000
17.00	012	002	365	00.00	0.00	0000	0000	1.39	0.00	01.35	00.235	19.56	2.12	2.58	2.41	000.000	00.000
17.30	012	002	357	00.00	0.00	0000	0000	1.31	0.00	01.14	00.213	19.45	2.18	2.62	2.39	000.000	00.000
18.00	012	002	326	00.00	0.00	0000	0000	1.23	0.00	01.30	00.247	19.47	2.14	2.61	2.36	000.000	00.000
18.30	012	002	323	00.00	0.00	0000	0000	1.15	0.00	01.31	00.251	19.36	2.13	2.53	2.34	000.000	00.000
19.00	012	002	327	00.00	0.00	0000	0000	1.11	0.00	01.13	00.221	19.54	2.17	2.55	2.32	000.000	00.000
19.30	012	002	325	00.00	0.00	0000	0000	0.95	0.00	01.44	00.193	19.30	2.17	2.53	2.31	000.000	00.000
20.00	012	002	325	00.00	0.00	0000	0000	0.90	0.00	00.90	00.190	19.77	2.14	2.51	2.29	000.000	00.000

TABLE 14: Medium cribs - 1 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	021	042	00.33	0.00	0000	0000	0.09	0.00	00.00	00.000	19.88	0.00	0.00	0.00	000.000	00.000
00.30	009	046	061	00.43	0.00	0000	0000	0.09	0.00	00.00	00.000	19.29	0.00	0.00	0.00	000.000	00.000
01.00	009	081	095	00.51	0.00	0000	0000	0.09	0.00	00.55	00.000	19.24	0.00	0.00	0.00	000.000	00.000
01.30	010	121	142	00.55	0.00	0000	0000	0.11	0.00	01.08	00.000	18.24	0.00	0.00	0.00	000.000	00.000
02.00	010	179	295	00.60	0.00	0000	0000	0.12	0.00	01.73	00.020	18.33	0.01	0.00	0.00	000.000	00.000
02.30	010	229	398	00.70	0.00	0000	0000	0.15	0.00	02.38	00.144	17.35	0.01	0.00	0.01	000.000	00.000
03.00	010	278	423	00.74	0.02	0000	0000	0.22	0.00	04.21	00.157	16.70	0.02	0.00	0.02	000.000	00.000
03.30	011	324	519	00.37	0.02	0000	0000	0.31	0.00	05.77	00.167	15.51	0.04	0.03	0.05	000.000	00.000
04.00	011	373	618	00.33	0.02	0000	0000	0.57	0.00	06.34	00.172	14.54	0.08	0.07	0.10	000.000	00.000
04.30	012	398	659	00.38	0.17	0000	0000	0.79	0.00	07.49	00.183	13.52	0.14	0.12	0.19	000.000	00.000
05.00	012	400	671	00.39	0.33	0000	0000	1.06	0.00	07.95	00.197	12.71	0.22	0.22	0.32	000.000	00.000
05.30	013	384	617	01.00	0.23	0000	0000	0.84	0.00	07.30	00.201	12.44	0.31	0.34	0.40	000.000	00.000
06.00	013	331	531	00.59	0.15	0000	0000	0.60	0.00	06.76	00.183	13.13	0.35	0.43	0.44	000.000	00.000
06.30	012	304	441	00.90	0.04	0000	0000	0.43	0.00	05.43	00.175	14.50	0.33	0.49	0.48	000.000	00.000
07.00	012	241	332	00.91	0.00	0000	0000	0.35	0.00	03.47	00.182	15.85	0.33	0.46	0.45	000.000	00.000
07.30	012	194	263	00.90	0.02	0000	0000	0.34	0.00	02.27	00.207	17.10	0.33	0.47	0.45	000.000	00.000
08.00	012	176	243	00.97	0.01	0000	0000	0.32	0.00	01.74	00.225	17.83	0.32	0.45	0.47	000.000	00.000
08.30	012	164	232	00.84	0.01	0000	0000	0.33	0.00	01.61	00.248	18.00	0.31	0.50	0.46	000.000	00.000
09.00	012	156	227	00.79	0.02	0000	0000	0.23	0.00	01.56	00.255	18.13	0.29	0.47	0.45	000.000	00.000
09.30	012	147	217	00.81	0.02	0000	0000	0.22	0.00	01.43	00.251	18.24	0.27	0.46	0.42	000.000	00.000
10.00	012	134	220	00.77	0.04	0000	0000	0.22	0.00	01.27	00.242	18.35	0.26	0.46	0.40	000.000	00.000
10.30	011	128	211	00.75	0.05	0000	0000	0.21	0.00	01.08	00.222	18.53	0.27	0.45	0.41	000.000	00.000
11.00	011	123	201	00.76	0.05	0000	0000	0.19	0.00	01.02	00.222	18.53	0.26	0.43	0.39	000.000	00.000
11.30	011	118	193	00.68	0.05	0000	0000	0.18	0.00	00.87	00.214	18.59	0.24	0.44	0.39	000.000	00.000
12.00	011	113	182	00.57	0.07	0000	0000	0.17	0.00	00.73	00.211	18.76	0.23	0.44	0.39	000.000	00.000
12.30	011	109	175	00.65	0.07	0000	0000	0.16	0.00	00.68	00.204	18.89	0.23	0.44	0.40	000.000	00.000
13.00	011	107	168	00.67	0.10	0000	0000	0.16	0.00	00.59	00.194	18.95	0.23	0.43	0.39	000.000	00.000
13.30	011	103	164	00.61	0.09	0000	0000	0.17	0.00	00.47	00.184	19.42	0.25	0.42	0.37	000.000	00.000
14.00	011	100	152	00.62	0.08	0000	0000	0.15	0.00	00.44	00.180	19.07	0.27	0.44	0.40	000.000	00.000
14.30	011	096	145	00.53	0.09	0000	0000	0.14	0.00	00.36	00.175	19.12	0.27	0.43	0.40	000.000	00.000
15.00	011	093	138	00.55	0.09	0000	0000	0.15	0.00	00.32	00.166	19.17	0.27	0.45	0.39	000.000	00.000
15.30	011	089	131	00.53	0.08	0000	0000	0.15	0.00	00.28	00.162	19.21	0.25	0.43	0.33	000.000	00.000
16.00	011	087	128	00.54	0.10	0000	0000	0.14	0.00	00.22	00.155	19.26	0.25	0.43	0.37	000.000	00.000
16.30	011	083	121	00.54	0.09	0000	0000	0.13	0.00	00.20	00.159	19.22	0.26	0.43	0.33	000.000	00.000
17.00	011	081	119	00.53	0.10	0000	0000	0.13	0.00	00.18	00.157	19.29	0.24	0.44	0.38	000.000	00.000
17.30	011	078	117	00.55	0.10	0000	0000	0.13	0.00	00.16	00.158	19.31	0.24	0.44	0.32	000.000	00.000
18.00	011	077	114	00.54	0.12	0000	0000	0.13	0.00	00.17	00.157	19.31	0.24	0.42	0.33	000.000	00.000
18.30	011	075	111	00.54	0.14	0000	0000	0.12	0.00	00.16	00.158	19.32	0.25	0.43	0.33	000.000	00.000
19.00	011	072	109	00.53	0.15	0000	0000	0.12	0.00	00.15	00.155	19.32	0.23	0.42	0.37	000.000	00.000
19.30	011	070	108	00.51	0.15	0000	0000	0.12	0.00	00.15	00.156	19.33	0.26	0.42	0.37	000.000	00.000
20.00	011	069	107	00.51	0.17	0000	0000	0.12	0.00	00.14	00.154	19.33	0.22	0.42	0.37	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	007	031	00.23	0.00	0000	0000	0.09	0.00	00.00	00.000	20.39	0.00	0.00	0.00	001.190	00.000
00.30	009	024	051	00.31	0.00	0000	0000	0.08	0.00	00.03	00.000	20.39	0.00	0.01	0.00	001.182	00.000
01.00	009	037	077	00.35	0.00	0000	0000	0.09	0.00	00.45	00.000	20.56	0.00	0.00	0.00	001.173	00.000
01.30	009	053	087	00.73	0.00	0000	0000	0.09	0.00	00.53	00.000	20.26	0.00	0.00	0.00	001.169	00.000
02.00	009	067	113	00.40	0.00	0000	0000	0.10	0.00	00.55	00.000	20.11	0.00	0.00	0.00	001.152	00.000
02.30	009	073	133	00.45	0.00	0000	0000	0.10	0.00	01.16	00.119	19.39	0.00	0.00	0.00	001.156	00.000
03.00	009	088	147	00.42	0.00	0000	0000	0.11	0.00	01.34	00.117	19.03	0.00	0.00	0.00	001.152	00.000
03.30	009	118	201	00.53	0.00	0000	0000	0.11	0.00	01.70	00.128	19.42	0.00	0.02	0.01	001.139	00.000
04.00	009	142	249	00.58	0.00	0000	0000	0.13	0.00	02.22	00.129	18.73	0.00	0.02	0.01	001.130	00.000
04.30	010	176	352	00.63	0.00	0000	0000	0.16	0.00	02.87	00.135	18.46	0.00	0.02	0.02	001.104	00.000
05.00	010	216	463	00.76	0.00	0000	0000	0.22	0.00	03.90	00.147	17.08	0.02	0.03	0.05	001.039	00.000
05.30	010	257	572	00.83	0.00	0000	0000	0.31	0.00	05.23	00.156	16.52	0.04	0.06	0.07	001.000	00.000
06.00	011	295	701	00.87	0.00	0000	0000	0.51	0.00	06.25	00.176	15.35	0.07	0.12	0.09	000.905	00.000
06.30	011	343	776	00.90	0.00	0000	0000	0.89	0.00	07.13	00.189	14.44	0.12	0.14	0.14	000.849	00.000
07.00	012	384	795	00.89	0.00	0000	0000	1.49	0.00	08.14	00.172	13.43	0.19	0.23	0.20	000.727	00.000
07.30	014	400	891	00.81	0.00	0000	0000	2.06	0.00	10.74	00.197	12.16	0.34	0.33	0.42	000.589	00.000
08.00	015	424	902	00.30	0.00	0000	0000	2.30	0.00	12.22	00.251	09.36	0.56	0.52	0.77	000.429	00.000
08.30	016	423	884	00.21	0.00	0000	0000	2.17	0.00	11.14	00.188	09.34	0.85	0.87	0.55	000.327	00.000
09.00	017	417	888	00.64	0.00	0000	0000	2.04	0.00	10.03	00.163	10.26	0.88	1.00	0.84	000.234	00.000
09.30	016	406	850	00.54	0.00	0000	0000	1.89	0.00	09.74	00.153	11.14	0.89	1.12	1.01	000.191	00.000
10.00	016	357	763	00.60	0.00	0000	0000	1.37	0.00	09.04	00.147	11.72	0.84	1.16	1.05	000.148	00.000
10.30	016	332	644	00.26	0.00	0000	0000	1.15	0.00	07.33	00.143	12.78	0.77	1.20	1.17	000.017	00.000
11.00	016	314	545	00.57	0.00	0000	0000	0.84	0.00	05.46	00.145	14.73	0.75	1.32	1.14	000.000	00.000
11.30	016	277	476	00.23	0.00	0000	0000	0.55	0.00	04.01	00.167	16.29	0.75	1.25	1.02	000.000	00.000
12.00	015	250	436	00.28	0.00	0000	0000	0.37	0.00	03.22	00.212	17.34	0.74	1.27	1.12	000.000	00.000
12.30	015	230	407	00.37	0.00	0000	0000	0.59	0.00	02.88	00.253	17.32	0.85	1.25	1.14	000.000	00.000
13.00	015	215	390	00.33	0.00	0000	0000	0.45	0.00	02.73	00.305	18.21	0.78	1.27	1.13	000.000	00.000
13.30	014	206	377	00.35	0.00	0000	0000	0.41	0.00	02.60	00.327	18.26	0.79	1.23	1.11	000.000	00.000
14.00	015	199	366	00.31	0.00	0000	0000	0.33	0.00	02.59	00.359	18.34	0.83	1.15	1.14	000.000	00.000
14.30	014	191	355	00.26	0.00	0000	0000	0.36	0.00	02.45	00.357	18.44	0.77	1.17	1.04	000.000	00.000
15.00	015	184	342	00.32	0.00	0000	0000	0.34	0.00	02.50	00.374	18.34	0.74	1.16	1.05	000.000	00.000
15.30	014	177	324	00.34	0.00	0000	0000	0.32	0.00	02.39	00.373	18.57	0.75	1.13	1.08	000.000	00.000
16.00	014	172	325	00.23	0.00	0000	0000	0.32	0.00	02.37	00.321	18.58	0.76	1.11	1.03	000.000	00.000
16.30	014	172	299	00.35	0.00	0000	0000	0.29	0.00	02.21	00.374	18.66	0.77	1.12	1.04	000.000	00.000
17.00	014	168	289	00.86	0.00	0000	0000	0.29	0.00	02.19	00.249	18.63	0.76	1.16	1.03	000.000	00.000
17.30	014	153	292	00.79	0.00	0000	0000	0.27	0.00	02.09	00.236	18.71	0.75	1.14	1.03	000.000	00.000
18.00	013	145	282	00.73	0.00	0000	0000	0.25	0.00	01.57	00.226	19.23	0.77	1.13	0.99	000.000	00.000
18.30	013	140	274	00.77	0.00	0000	0000	0.24	0.00	01.54	00.222	19.34	0.79	1.16	1.01	000.000	00.000
19.00	013	133	270	00.62	0.00	0000	0000	0.23	0.00	01.46	00.215	19.40	0.75	1.15	1.01	000.000	00.000
19.30	013	132	263	00.77	0.00	0000	0000	0.21	0.00	01.37	00.206	19.59	0.78	1.17	1.00	000.000	00.000
20.00	013	126	256	00.77	0.00	0000	0000	0.21	0.00	01.33	00.204	19.53	0.77	1.14	1.03	000.000	00.000

TABLE 15: Medium cribs - 1 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	022	042	00.25	0.00	0000	0000	0.20	0.00	00.00	00.000	21.09	0.00	0.00	0.00	001.227	00.000
00.30	010	044	088	00.40	0.00	0000	0000	0.10	0.00	00.00	00.000	21.12	0.00	0.00	0.00	001.196	00.000
01.00	010	065	130	00.44	0.00	0000	0000	0.10	0.00	00.00	00.000	21.12	0.00	0.00	0.00	001.173	00.000
01.30	010	081	150	00.45	0.00	0000	0000	0.09	0.00	00.00	00.000	21.13	0.00	0.00	0.00	001.174	00.000
02.00	010	120	216	00.47	0.00	0000	0000	0.10	0.00	00.00	00.092	21.10	0.00	0.00	0.00	001.156	00.000
02.30	010	130	252	00.49	0.00	0000	0000	0.10	0.00	00.00	00.295	21.04	0.00	0.00	0.00	001.149	00.000
03.00	010	179	393	00.57	0.00	0000	0000	0.12	0.00	00.08	00.392	20.50	0.01	0.01	0.01	001.133	00.000
03.30	010	221	509	00.57	0.00	0000	0000	0.14	0.00	00.15	00.359	20.27	0.02	0.00	0.03	001.100	00.000
04.00	010	283	713	00.64	0.00	0000	0000	0.20	0.00	00.26	00.487	20.04	0.05	0.10	0.06	001.06	00.000
04.30	010	374	750	00.67	0.00	0000	0000	0.35	0.00	00.46	00.492	20.36	0.16	0.14	0.14	000.993	00.000
05.00	011	571	710	00.59	0.00	0000	0000	0.88	0.00	00.77	00.292	20.74	0.48	0.36	0.46	000.913	00.000
05.30	011	644	664	00.53	0.00	0000	0000	1.39	0.00	01.19	00.495	20.53	0.46	0.55	0.42	000.852	00.000
06.00	011	675	652	00.46	0.00	0000	0000	1.72	0.00	01.65	00.196	20.29	0.62	0.71	0.53	000.742	00.000
06.30	011	672	687	00.43	0.00	0000	0000	1.97	0.00	02.24	00.163	19.96	0.77	0.94	0.72	000.652	00.000
07.00	012	663	709	00.48	0.00	0000	0000	2.19	0.00	03.48	00.132	19.45	0.99	1.24	1.05	000.552	00.000
07.30	012	645	723	00.45	0.00	0000	0000	2.33	0.00	05.03	00.196	16.25	1.18	1.34	1.35	000.449	00.000
08.00	012	595	749	00.47	0.00	0000	0000	2.22	0.00	06.93	00.111	17.72	1.40	1.70	1.50	000.367	00.000
08.30	013	511	772	00.52	0.00	0000	0000	1.88	0.00	09.21	00.113	16.75	1.52	1.67	1.56	000.293	00.000
09.00	013	402	781	00.54	0.00	0000	0000	1.13	0.00	11.29	00.215	15.44	1.75	2.09	1.92	000.234	00.000
09.30	013	364	751	00.54	0.00	0000	0000	0.63	0.00	12.73	01.337	14.43	1.73	2.47	2.37	000.177	00.000
10.00	013	329	710	00.57	0.00	0000	0000	0.66	0.00	12.77	00.359	12.49	1.46	2.21	1.92	000.114	00.000
10.30	012	304	669	00.44	0.00	0000	0000	0.53	0.00	12.17	00.191	10.21	1.48	2.34	1.76	000.106	00.000
11.00	012	289	640	00.59	0.00	0000	0000	0.50	0.00	12.00	00.142	09.46	1.47	2.10	2.01	000.098	00.000
11.30	012	280	623	00.55	0.00	0000	0000	0.45	0.00	11.50	00.114	10.29	1.40	2.05	1.73	000.090	00.000
12.00	012	269	610	00.57	0.00	0000	0000	0.42	0.00	11.38	00.144	11.62	1.40	2.04	2.08	000.082	00.000
12.30	012	256	586	00.55	0.00	0000	0000	0.38	0.00	11.54	00.404	12.60	1.39	2.14	1.90	000.082	00.000
13.00	012	247	570	00.55	0.00	0000	0000	0.35	0.00	11.13	00.103	13.40	1.37	2.26	1.84	000.077	00.000
13.30	012	241	556	00.56	0.00	0000	0000	0.34	0.00	09.26	00.144	14.14	1.40	1.97	1.88	000.069	00.000
14.00	012	233	546	00.57	0.00	0000	0000	0.32	0.00	07.25	00.112	15.75	1.46	2.02	1.76	000.069	00.000
14.30	012	227	530	00.55	0.00	0000	0000	0.30	0.00	05.71	00.113	17.31	1.40	2.03	1.53	000.065	00.000
15.00	012	223	522	00.56	0.00	0000	0000	0.29	0.00	04.85	00.114	18.12	1.43	1.70	1.74	000.062	00.000
15.30	012	216	510	00.59	0.00	0000	0000	0.23	0.00	04.49	00.117	18.48	1.41	2.01	1.71	000.057	00.000
16.00	012	210	497	00.55	0.00	0000	0000	0.25	0.00	04.22	00.116	20.73	1.42	2.02	1.76	000.057	00.000
16.30	012	206	478	00.57	0.00	0000	0000	0.25	0.00	04.13	00.116	20.74	1.45	2.01	1.67	000.061	00.000
17.00	012	198	459	00.54	0.00	0000	0000	0.24	0.00	04.19	00.117	20.73	1.45	1.97	1.74	000.057	00.000
17.30	012	190	445	00.54	0.00	0000	0000	0.23	0.00	03.74	00.117	20.75	1.48	2.03	1.72	000.053	00.000
18.00	012	184	426	00.55	0.00	0000	0000	0.22	0.00	00.71	00.122	20.75	1.52	1.97	1.68	000.053	00.000
18.30	012	182	412	00.54	0.00	0000	0000	0.22	0.00	00.70	00.121	20.58	1.44	1.90	1.66	000.053	00.000
19.00	012	175	401	00.54	0.00	0000	0000	0.21	0.00	00.62	00.116	20.61	1.44	2.03	1.70	000.053	00.000
19.30	012	171	389	00.54	0.00	0000	0000	0.20	0.00	00.59	00.109	20.63	1.46	1.72	1.65	000.053	00.000
20.00	012	167	376	00.51	0.00	0000	0000	0.19	0.00	00.26	00.100	20.57	1.47	2.00	1.67	000.045	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	017	040	00.27	0.00	0000	0000	0.09	0.00	00.00	00.094	18.48	0.00	0.00	0.00	001.207	00.000
00.30	010	024	061	00.33	0.00	0000	0000	0.09	0.00	00.00	00.068	18.64	0.00	0.00	0.00	001.165	00.000
01.00	010	032	094	00.36	0.00	0000	0000	0.08	0.00	00.00	00.063	18.83	0.00	0.00	0.00	001.165	00.000
01.30	010	049	140	00.37	0.00	0000	0000	0.07	0.00	00.00	00.064	18.79	0.00	0.00	0.00	001.152	00.000
02.00	010	070	202	00.42	0.00	0000	0000	0.09	0.00	00.15	00.072	18.73	0.01	0.00	0.01	001.147	00.000
02.30	010	089	262	00.46	0.00	0000	0000	0.10	0.00	00.51	00.073	18.46	0.01	0.00	0.01	001.136	00.000
03.00	010	119	337	00.51	0.00	0000	0000	0.11	0.00	00.71	00.069	18.20	0.02	0.01	0.02	001.126	00.000
03.30	010	153	462	00.57	0.00	0000	0000	0.13	0.00	00.96	00.069	18.43	0.04	0.02	0.04	001.110	00.000
04.00	010	174	686	00.61	0.00	0000	0000	0.18	0.00	01.27	00.073	17.77	0.10	0.04	0.07	001.074	00.000
04.30	010	251	759	00.65	0.00	0000	0000	0.23	0.00	01.95	00.088	17.38	0.16	0.10	0.15	001.019	00.000
05.00	010	333	732	00.61	0.00	0000	0000	0.77	0.00	02.79	00.141	16.73	0.30	0.13	0.29	000.961	00.000
05.30	010	467	671	00.59	0.00	0000	0000	1.35	0.00	03.13	00.391	16.03	0.58	0.45	0.43	000.874	00.000
06.00	011	505	733	00.47	0.00	0000	0000	2.02	0.00	04.01	00.502	15.73	0.67	0.58	0.59	000.812	00.000
06.30	011	513	835	00.41	0.00	0000	0000	2.29	0.00	05.82	01.025	15.45	0.74	0.71	0.77	000.735	00.000
07.00	012	526	841	00.42	0.00	0000	0000	2.70	0.00	05.47	01.249	13.74	0.92	0.86	0.73	000.660	00.000
07.30	012	532	910	00.44	0.00	0000	0000	2.76	0.00	05.66	01.225	11.64	1.22	1.15	1.19	000.565	00.000
08.00	012	527	990	00.46	0.00	0000	0000	3.08	0.00	07.17	01.093	08.64	1.21	1.33	1.49	000.513	00.000
08.30	012	508	912	00.46	0.00	0000	0000	3.01	0.00	09.45	00.763	08.37	1.40	1.61	1.62	000.46	00.000
09.00	013	446	856	00.45	0.00	0000	0000	2.30	0.00	13.41	00.384	09.65	1.73	1.87	1.89	000.405	00.000
09.30	013	389	841	00.50	0.00	0000	0000	1.46	0.00	13.63	00.723	11.05	1.97	2.11	2.20	000.372	00.000
10.00	014	316	893	00.51	0.00	0000	0000	1.34	0.00	12.21	00.726	12.23	1.83	2.16	2.14	000.362	00.000
10.30	013	284	717	00.49	0.00	0000	0000	0.85	0.00	12.25	00.653	15.23	1.61	2.13	1.96	000.355	00.000
11.00	013	263	675	00.49	0.00	0000	0000	0.67	0.00	09.35	00.579	16.25	1.68	2.29	2.06	000.35	00.000
11.30	013	250	654	00.56	0.00	0000	0000	0.69	0.00	08.25	00.523	16.33	1.63	2.09	2.20	000.337	00.000
12.00	013	233	630	00.53	0.00	0000	0000	0.55	0.00	05.30	00.478	18.94	1.59	2.01	1.96	000.324	00.000
12.30	013	223	611	00.54	0.00	0000	0000	0.52	0.00	03.00	00.440	18.77	1.61	2.14	2.30	000.314	00.000
13.00	013	222	584	00.54	0.00	0000	0000	0.43	0.00	02.04	00.342	18.86	1.67	2.15	1.97	000.304	00.000
13.30	013	209	449	00.53	0.00	0000	0000	0.45	0.00	01.84	00.231	19.01	1.53	1.99	1.93	000.295	00.000
14.00	013	200	432	00.53	0.00	0000	0000	0.37	0.00	01.67	00.271	19.30	1.61	1.90	1.29	000.291	00.000
14.30	013	195	412	00.53	0.00	0000	0000	0.37	0.00	01.40	00.233	19.30	1.56	1.95	1.65	000.273	00.000
15.00	013	189	420	00.53	0.00	0000	0000	0.34	0.00	01.22	00.205	19.48	1.52	1.97	1.86	000.272	00.000
15.30	013	183	410	00.51	0.00	0000	0000	0.36	0.00	01.12	00.164	19.53	1.54	1.74	1.86	000.265	00.000
16.00	013	178	396	00.51	0.00	0000	0000	0.30	0.00	01.03	00.161	19.55	1.55	2.01	1.80	000.259	00.000
16.30	013	174	387	00.51	0.00	0000	0000	0.30	0.00	00.75	00.141	19.56	1.56	1.37	1.81	000.252	00.000
17.00	013	171	380	00.49	0.00	0000	0000	0.23	0.00	00.87	00.132	19.45	1.51	1.96	1.75	000.24	00.000
17.30	013	167	373	00.51	0.00	0000	0000	0.27	0.00	00.70	00.132	19.47	1.53	1.70	1.75	000.236	00.000
18.00	013	165	410	00.50	0.00	0000	0000	0.26	0.00	00.67	00.141	19.36	1.49	1.70	1.75	000.229	00.000
18.30	013	161	397	00.52	0.00	0000	0000	0.25	0.00	00.62	00.134	19.80	1.51	1.87	1.70	000.223	00.000
19.00	012	156	399	00.52	0.00	0000	0000	0.23	0.00	00.54	00.128	19.85	1.54	1.95	1.72	000.217	00.000
19.30	012	151	383	00.52	0.00	0000	0000	0.23	0.00	00.48	00.123	19.94	1.53	1.89	1.67	000.214	00.000
20.00	012	147	372	00.52	0.00	0000	0000	0.23	0.00	00.45	00.117	19.99	1.52	1.96	1.72	000.207	00.000

TABLE 16: Medium cribs - 2 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	010	036	00.24	0.00	0000	0000	0.09	0.00	00.00	00.000	20.44	0.00	0.00	0.00	001.165	00.000
00.30	009	020	050	00.34	0.00	0000	0000	0.09	0.00	00.00	00.000	20.38	0.00	0.00	0.00	001.157	00.000
01.00	009	028	075	00.35	0.00	0000	0000	0.08	0.00	00.26	00.000	20.30	0.00	0.00	0.00	001.157	00.000
01.30	009	041	103	00.37	0.01	0000	0000	0.09	0.00	00.70	00.000	20.29	0.00	0.00	0.00	001.147	00.000
02.00	009	052	129	00.39	0.00	0000	0000	0.09	0.00	01.10	00.000	19.92	0.01	0.00	0.00	001.138	00.000
02.30	009	067	143	00.45	0.00	0000	0000	0.09	0.00	01.35	00.005	19.61	0.01	0.00	0.00	001.133	00.000
03.00	009	085	179	00.47	0.00	0000	0000	0.10	0.00	01.65	00.092	19.31	0.01	0.00	0.00	001.099	00.000
03.30	009	107	232	00.49	0.03	0000	0000	0.14	0.00	02.25	00.093	18.95	0.01	0.01	0.00	001.076	00.000
04.00	009	133	294	00.57	0.02	0000	0000	0.10	0.00	02.79	00.103	18.37	0.03	0.01	0.01	000.995	00.000
04.30	009	159	394	00.65	0.02	0000	0000	0.13	0.00	03.65	00.106	17.71	0.04	0.03	0.04	000.979	00.000
05.00	009	199	514	00.71	0.01	0000	0000	0.16	0.00	04.81	00.119	16.35	0.06	0.05	0.06	000.349	00.000
05.30	009	232	690	00.76	0.01	0000	0000	0.21	0.00	06.21	00.132	15.47	0.09	0.07	0.09	000.744	00.000
06.00	009	266	696	00.79	0.00	0000	0000	0.30	0.00	07.40	00.149	14.19	0.11	0.12	0.12	000.649	00.000
06.30	010	291	760	00.78	0.03	0000	0000	0.53	0.00	08.70	00.131	12.88	0.15	0.15	0.19	000.498	00.000
07.00	010	312	797	00.80	0.73	0000	0000	0.77	0.00	09.71	00.163	11.74	0.21	0.22	0.23	000.365	00.000
07.30	010	329	857	00.82	0.31	0000	0000	1.09	0.00	11.29	00.273	10.64	0.43	0.35	0.46	000.166	00.000
08.00	011	340	867	00.80	0.19	0000	0000	1.13	0.00	11.42	00.235	09.53	0.58	0.55	0.68	000.047	00.000
08.30	011	341	854	00.82	0.15	0000	0000	1.29	0.00	10.57	00.181	09.95	0.66	0.66	0.87	000.000	00.000
09.00	011	343	801	00.83	0.12	0000	0000	1.04	0.00	09.70	00.153	10.69	0.73	0.83	0.95	000.000	00.000
09.30	011	336	741	00.80	0.18	0000	0000	1.00	0.00	08.56	00.137	11.81	0.72	0.59	1.21	000.000	00.000
10.00	011	322	668	00.82	0.18	0000	0000	0.86	0.00	07.28	00.134	12.95	0.78	1.00	1.09	000.000	00.000
10.30	011	301	587	00.90	0.12	0000	0000	0.73	0.00	05.89	00.140	14.26	0.89	1.10	1.22	000.000	00.000
11.00	011	278	503	00.81	0.10	0000	0000	0.52	0.00	04.86	00.161	15.45	0.87	1.17	1.21	000.000	00.000
11.30	011	255	457	00.83	0.07	0000	0000	0.56	0.00	03.61	00.292	16.40	0.87	1.18	1.17	000.000	00.000
12.00	011	234	421	00.83	0.13	0000	0000	0.40	0.00	03.23	00.255	17.29	0.94	1.18	1.21	000.000	00.000
12.30	011	219	401	00.80	0.14	0000	0000	0.41	0.00	02.90	00.306	17.75	0.88	1.25	1.13	000.000	00.000
13.00	011	206	390	00.81	0.12	0000	0000	0.38	0.00	02.73	00.338	17.95	0.87	1.25	1.08	000.000	00.000
13.30	011	199	377	00.84	0.15	0000	0000	0.37	0.00	02.67	00.357	18.05	0.81	1.19	1.04	000.000	00.000
14.00	011	191	364	00.86	0.19	0000	0000	0.32	0.00	02.53	00.392	18.15	0.79	1.22	1.01	000.000	00.000
14.30	011	182	345	00.83	0.21	0000	0000	0.32	0.00	02.43	00.406	18.27	0.83	1.11	0.98	000.000	00.000
15.00	011	175	328	00.83	0.30	0000	0000	0.26	0.00	02.09	00.336	18.56	0.78	1.10	1.00	000.000	00.000
15.30	011	165	309	00.82	0.27	0000	0000	0.24	0.00	01.85	00.237	18.72	0.82	1.11	0.99	000.000	00.000
16.00	011	159	308	00.79	0.31	0000	0000	0.23	0.00	01.66	00.237	19.06	0.85	1.11	0.99	000.000	00.000
16.30	011	152	308	00.76	0.32	0000	0000	0.24	0.00	01.49	00.216	19.21	0.79	1.12	1.00	000.000	00.000
17.00	010	147	298	00.74	0.30	0000	0000	0.23	0.00	01.38	00.206	19.33	0.88	1.09	0.93	000.000	00.000
17.30	011	143	291	00.73	0.33	0000	0000	0.22	0.00	01.31	00.207	19.42	0.78	1.10	0.99	000.000	00.000
18.00	011	138	292	00.70	0.31	0000	0000	0.23	0.00	01.27	00.203	19.46	0.84	1.11	1.00	000.000	00.000
18.30	011	134	292	00.75	0.34	0000	0000	0.22	0.00	01.16	00.193	19.57	0.84	1.11	0.97	000.000	00.000
19.00	011	131	289	00.77	0.36	0000	0000	0.21	0.00	01.11	00.188	19.62	0.79	1.09	0.98	000.000	00.000
19.30	011	128	284	00.72	0.38	0000	0000	0.19	0.00	01.09	00.186	19.67	0.74	1.09	0.98	000.000	00.000
20.00	011	125	277	00.69	0.33	0000	0000	0.19	0.00	01.03	00.182	19.79	0.79	1.10	0.98	000.000	00.000

TABLE 16: Medium cribs - 2 m corridor - 40 cm opening (cont.).

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	057	155	00.00	00.0	0000	0000	0.08	0.00	00.00	00.000	20.00	0.00	0.00	0.00	000.556	00.000
00.30	014	088	160	00.59	00.0	0000	0000	0.08	0.00	00.30	00.000	20.43	0.00	0.00	0.00	001.073	00.000
01.00	014	109	166	00.56	00.0	0000	0000	0.08	0.00	00.79	00.000	20.50	0.00	0.00	0.00	000.761	00.000
01.30	014	123	171	00.60	00.0	0000	0000	0.09	0.00	00.74	00.073	19.89	0.00	0.00	0.00	000.554	00.000
02.00	014	136	178	00.62	00.0	0000	0000	0.09	0.00	01.31	00.081	19.69	0.00	0.00	0.00	000.761	00.000
02.30	014	151	198	00.68	00.0	0000	0000	0.09	0.00	01.65	00.083	19.47	0.00	0.00	0.00	000.756	00.000
03.00	014	165	200	00.22	00.1	0000	0000	0.10	0.00	02.01	00.065	19.48	0.00	0.00	0.00	000.773	00.000
03.30	014	197	224	00.77	00.1	0000	0000	0.11	0.00	02.33	00.000	18.88	0.00	0.00	0.00	000.761	00.000
04.00	014	239	271	00.77	00.5	0001	0000	0.12	0.00	02.86	00.084	18.35	0.00	0.00	0.00	000.317	00.000
04.30	014	279	312	00.86	00.3	0002	0000	0.15	0.00	03.77	00.087	17.72	0.00	0.00	0.00	000.267	00.000
05.00	014	314	359	00.38	01.5	0005	0002	0.21	0.00	05.56	00.115	16.75	0.00	0.00	0.00	000.812	00.000
05.30	014	347	374	00.76	02.6	0009	0005	0.23	0.00	06.57	00.125	15.40	0.00	0.00	0.00	000.776	00.000
06.00	014	375	402	00.33	07.8	0025	0014	0.40	0.00	08.93	00.156	14.43	0.00	0.00	0.00	000.670	00.000
06.30	014	377	416	01.46	09.4	0035	0031	0.49	0.00	11.22	00.179	12.49	0.00	0.00	0.00	000.279	00.000
07.00	014	405	691	01.44	09.6	0036	0044	0.55	0.00	12.77	00.279	10.21	0.00	0.00	0.00	000.55	00.000
07.30	014	412	576	00.94	06.2	0023	0062	1.17	0.00	11.02	00.152	09.36	0.00	0.00	0.00	000.576	00.000
08.00	014	467	435	01.45	07.2	0012	0077	0.38	0.00	10.07	00.126	10.33	0.00	0.00	0.00	000.571	00.000
08.30	014	462	473	01.14	07.1	0013	0081	0.79	0.00	08.64	00.112	11.28	0.00	0.00	0.00	000.577	00.000
09.00	014	384	378	01.07	02.1	0000	0087	0.65	0.00	07.55	00.166	12.20	0.00	0.00	0.00	000.425	00.000
09.30	014	367	374	00.91	01.2	0004	0089	0.53	0.00	06.00	00.055	13.40	0.00	0.00	0.00	000.437	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	012	029	072	00.00	00.0	0000	0000	0.09	0.00	00.00	00.000	20.34	0.00	0.00	0.00	000.000	00.000
00.30	012	047	077	00.37	00.0	0000	0000	0.10	0.00	00.00	00.000	20.22	0.00	0.00	0.00	000.000	00.000
01.00	012	064	083	00.45	00.0	0000	0000	0.10	0.00	00.11	00.072	20.33	0.00	0.00	0.00	000.000	00.000
01.30	012	079	088	00.50	00.0	0000	0000	0.09	0.00	00.43	00.087	20.31	0.00	0.00	0.00	000.000	00.000
02.00	012	101	103	00.51	00.0	0000	0000	0.09	0.00	00.77	00.097	19.33	0.00	0.00	0.00	000.000	00.000
02.30	012	129	121	00.59	00.0	0000	0000	0.10	0.00	01.17	00.081	18.53	0.00	0.00	0.00	000.000	00.000
03.00	012	137	131	00.00	00.0	0000	0000	0.10	0.00	01.33	00.075	16.42	0.00	0.00	0.00	000.000	00.000
03.30	012	151	141	00.53	00.0	0000	0000	0.10	0.00	02.17	00.077	15.66	0.00	0.00	0.00	000.000	00.000
04.00	012	170	157	00.63	00.2	0000	0000	0.12	0.00	02.50	00.081	16.41	0.00	0.00	0.00	000.000	00.000
04.30	012	207	191	00.76	00.3	0001	0000	0.13	0.00	02.78	00.088	16.76	0.00	0.00	0.00	000.000	00.000
05.00	012	247	229	00.77	00.1	0000	0000	0.15	0.00	03.41	00.092	17.37	0.00	0.00	0.00	000.000	00.000
05.30	012	275	266	00.82	01.0	0002	0000	0.19	0.00	04.36	00.143	17.21	0.00	0.00	0.00	000.000	00.000
06.00	012	315	282	00.82	01.5	0004	0000	0.38	0.00	05.55	00.112	15.54	0.00	0.00	0.00	000.000	00.000
06.30	012	344	341	00.75	05.3	0029	0008	0.58	0.00	07.33	00.125	14.50	0.00	0.00	0.00	000.000	00.000
07.00	012	351	314	00.75	09.0	0029	0023	0.88	0.00	07.33	00.129	13.30	0.00	0.00	0.00	000.000	00.000
07.30	012	359	603	00.46	06.1	0019	0033	1.05	0.00	12.49	00.178	11.23	0.00	0.00	0.00	000.000	00.000
08.00	012	369	634	00.97	06.7	0021	0046	0.44	0.00	10.57	00.17	09.24	0.00	0.00	0.00	000.000	00.000
08.30	012	366	599	00.71	07.1	0022	0054	0.44	0.00	10.63	00.123	10.36	0.00	0.00	0.00	000.000	00.000
09.00	012	357	577	00.94	02.2	0007	0060	0.41	0.00	09.29	00.112	11.22	0.00	0.00	0.00	000.000	00.000
09.30	012	333	569	00.24	01.6	0004	0065	0.34	0.00	09.87	00.095	11.34	0.00	0.00	0.00	000.000	00.000
10.00	012	306	543	00.99	01.9	0000	0065	0.25	0.00	06.00	00.095	12.76	0.00	0.00	0.00	000.000	00.000
10.30	012	273	540	00.92	00.2	0002	0066	0.23	0.00	05.12	00.096	14.45	0.00	0.00	0.00	000.000	00.000
11.00	012	245	523	00.30	00.5	0001	0065	0.19	0.00	03.78	00.107	15.73	0.00	0.00	0.00	000.000	00.000
11.30	012	223	511	00.30	00.0	0000	0062	0.18	0.00	02.74	00.132	16.33	0.00	0.00	0.00	000.000	00.000
12.00	012	217	501	00.25	00.0	0000	0062	0.16	0.00	02.52	00.172	17.82	0.00	0.00	0.00	000.000	00.000

TABLE 17: Medium cribs - 2 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	066	110	00.47	0.00	0000	0000	0.10	0.00	00.00	00.197	18.91	0.00	0.00	0.00	001.22	00.000
00.30	011	080	116	00.57	0.00	0000	0000	0.10	0.00	00.00	00.117	18.91	0.00	0.00	0.00	001.161	00.000
01.00	011	102	178	00.57	0.01	0000	0000	0.10	0.00	00.00	00.132	18.76	0.00	0.00	0.00	001.157	00.000
01.30	011	119	253	00.51	0.01	0000	0000	0.11	0.00	00.52	00.140	18.45	0.01	0.00	0.00	001.139	00.000
02.00	011	143	351	00.53	0.04	0000	0000	0.11	0.00	00.87	00.179	18.17	0.01	0.00	0.01	001.125	00.000
02.30	011	171	462	00.55	0.07	0000	0000	0.12	0.00	01.68	00.149	17.72	0.03	0.01	0.02	001.098	00.000
03.00	011	212	644	00.57	0.12	0000	0000	0.14	0.00	02.77	00.165	17.49	0.06	0.02	0.03	001.049	00.000
03.30	011	261	758	00.62	0.10	0000	0000	0.17	0.00	04.67	00.222	15.92	0.10	0.05	0.06	000.988	00.000
04.00	011	326	797	00.68	0.57	0000	0000	0.23	0.00	05.31	00.717	14.32	0.20	0.15	0.21	000.900	00.000
04.30	012	437	658	00.67	0.30	0000	0000	0.52	0.00	08.75	00.885	12.30	0.51	0.32	0.35	000.792	00.000
05.00	012	451	792	00.65	0.44	0000	0000	0.71	0.00	10.34	01.032	10.33	0.55	0.44	0.42	000.653	00.000
05.30	012	457	740	00.64	0.37	0000	0000	0.92	0.00	10.67	01.170	09.33	0.77	0.66	0.72	000.523	00.000
06.00	012	467	774	00.71	0.53	0000	0000	1.13	0.00	10.30	01.116	09.34	1.12	0.90	0.98	000.419	00.000
06.30	012	456	587	00.63	0.53	0000	0000	1.33	0.00	10.71	00.952	09.17	1.35	1.24	1.39	000.315	00.000
07.00	012	447	833	00.62	0.65	0000	0000	1.42	0.00	10.27	00.889	09.34	1.53	1.49	1.42	000.212	00.000
07.30	013	440	874	00.59	0.62	0000	0000	1.42	0.00	09.23	00.721	09.31	1.55	1.83	1.63	000.149	00.000
08.00	013	404	910	00.57	0.56	0000	0000	1.15	0.00	07.72	00.404	10.61	2.24	2.11	1.84	000.032	00.000
08.30	013	380	995	00.59	0.16	0000	0000	0.83	0.00	05.49	00.255	12.24	2.24	2.46	2.16	000.000	00.000
09.00	013	357	767	00.62	0.12	0000	0000	0.65	0.00	03.20	00.139	14.02	2.12	2.51	2.17	000.000	00.000
09.30	013	333	716	00.63	0.22	0000	0000	0.35	0.00	02.32	00.173	15.38	1.95	2.74	2.33	000.000	00.000
10.00	013	319	675	00.53	0.23	0000	0000	0.48	0.00	02.17	00.188	15.62	1.85	2.51	1.79	000.000	00.000
10.30	013	307	654	00.56	0.25	0000	0000	0.45	0.00	02.43	00.225	16.31	1.75	2.45	1.89	000.000	00.000
11.00	013	293	632	00.57	0.36	0000	0000	0.40	0.00	02.05	00.263	16.35	1.74	2.31	1.39	000.000	00.000
11.30	013	289	614	00.61	0.26	0000	0000	0.38	0.00	02.12	00.348	16.35	1.68	2.24	1.89	000.000	00.000
12.00	013	281	601	00.62	0.45	0000	0000	0.35	0.00	02.08	00.339	16.32	1.73	2.19	1.80	000.000	00.000
12.30	013	271	575	00.61	0.46	0000	0000	0.33	0.00	01.94	00.359	16.84	1.79	2.18	1.79	000.000	00.000
13.00	013	261	559	00.62	0.51	0000	0000	0.31	0.00	01.74	00.324	16.94	1.77	2.10	1.78	000.000	00.000
13.30	013	254	543	00.62	0.50	0000	0000	0.30	0.00	01.68	00.315	17.10	1.77	2.11	1.81	000.000	00.000
14.00	013	248	543	00.60	0.58	0000	0000	0.23	0.00	01.66	00.310	17.17	1.73	2.04	1.77	000.000	00.000
14.30	013	243	531	00.60	0.54	0000	0000	0.27	0.00	01.54	00.343	17.20	1.79	2.06	1.79	000.000	00.000
15.00	013	233	516	00.59	0.54	0000	0000	0.26	0.00	01.52	00.315	17.27	1.80	2.01	1.74	000.000	00.000
15.30	013	232	506	00.60	0.65	0000	0000	0.27	0.00	01.51	00.304	17.23	1.50	2.06	1.78	000.000	00.000
16.00	013	223	496	00.59	0.66	0000	0000	0.24	0.00	01.47	00.298	17.34	1.77	2.05	1.76	000.000	00.000
16.30	013	221	490	00.60	0.62	0000	0000	0.23	0.00	01.42	00.289	17.35	1.77	1.96	1.75	000.000	00.000
17.00	013	215	481	00.60	0.53	0000	0000	0.22	0.00	01.29	00.261	17.40	1.75	1.91	1.75	000.000	00.000
17.30	013	211	467	00.60	0.59	0000	0000	0.22	0.00	01.27	00.246	17.48	1.74	1.93	1.73	000.000	00.000
18.00	013	205	458	00.61	0.73	0000	0000	0.21	0.00	01.19	00.234	17.52	1.73	1.94	1.72	000.000	00.000
18.30	013	207	446	00.62	0.76	0000	0000	0.21	0.00	01.13	00.229	17.59	1.72	1.93	1.72	000.000	00.000
19.00	013	196	436	00.53	0.79	0000	0000	0.20	0.00	01.05	00.246	17.60	1.71	1.56	1.74	000.000	00.000
19.30	013	192	424	00.61	0.73	0000	0000	0.19	0.00	01.01	00.202	17.72	1.70	1.26	1.72	000.000	00.000
20.00	013	185	413	00.57	0.84	0000	0000	0.17	0.00	00.94	00.196	17.75	1.69	1.84	1.71	000.000	00.000

TABLE 17: Medium cribs - 2 m corridor - 10 cm opening (cont.)

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	026	048	00.00	00.0	0000	0000	0.07	0.00	00.00	00.069	20.79	0.00	0.00	0.00	025.524	00.000
00.30	013	049	054	00.27	00.0	0000	0000	0.07	0.00	00.00	00.063	20.62	0.00	0.00	0.00	025.461	00.000
01.00	013	072	153	00.35	00.0	0000	0000	0.03	0.00	00.67	00.075	20.31	0.00	0.00	0.00	025.487	00.000
01.30	013	095	233	00.45	00.0	0000	0000	0.07	0.00	01.21	00.069	19.76	0.00	0.00	0.00	025.473	00.000
02.00	013	129	279	00.53	00.1	0000	0000	0.08	0.00	01.73	00.088	19.41	0.00	0.00	0.00	025.457	00.000
02.30	013	161	405	00.36	00.3	0000	0000	0.08	0.00	02.45	00.088	19.16	0.00	0.00	0.00	025.471	00.000
03.00	013	203	580	00.60	01.7	0003	0000	0.19	0.00	03.26	00.090	18.52	0.00	0.00	0.00	025.420	00.000
03.30	013	265	520	00.63	04.3	0009	0002	0.12	0.00	04.52	00.097	17.61	0.00	0.00	0.00	025.397	00.000
04.00	013	331	704	00.74	04.2	0009	0009	0.13	0.00	06.65	00.137	16.56	0.00	0.00	0.00	025.356	00.000
04.30	013	405	785	00.77	03.3	0009	0017	0.27	0.00	08.34	00.097	14.73	0.00	0.00	0.00	025.254	00.000
05.00	013	419	789	00.81	06.7	0021	0022	0.34	0.00	11.27	00.353	12.77	0.00	0.00	0.00	025.183	00.000
05.30	013	418	803	00.77	07.6	0022	0034	0.39	0.00	13.64	01.046	06.79	0.00	0.00	0.00	025.117	00.000
06.00	013	411	817	00.79	09.5	0027	0050	0.46	0.00	13.63	01.228	08.32	0.00	0.00	0.00	025.043	00.000
06.30	013	421	822	00.75	04.0	0011	0063	1.43	0.00	13.16	01.164	08.44	0.00	0.00	0.00	024.949	00.000
07.00	013	419	823	00.73	08.9	0024	0080	1.27	0.00	12.21	00.957	08.73	0.00	0.00	0.00	024.880	00.000
07.30	013	409	806	00.76	08.3	0023	0093	1.10	0.00	12.71	00.717	09.37	0.00	0.00	0.00	024.843	00.000
08.00	013	384	747	00.75	03.4	0009	0104	0.99	0.00	09.34	00.426	12.24	0.00	0.00	0.00	024.797	00.000
08.30	013	373	739	00.74	01.1	0003	0107	0.89	0.00	07.94	00.267	11.32	0.00	0.00	0.00	024.758	00.000
09.00	013	348	663	00.77	00.6	0002	0107	0.80	0.00	05.86	00.137	13.39	0.00	0.00	0.00	024.786	00.000
09.30	013	323	634	00.68	00.1	0000	0107	0.74	0.00	04.19	00.118	15.66	0.00	0.00	0.00	024.774	00.000
10.00	013	306	593	00.72	00.6	0001	0107	0.67	0.00	02.94	00.120	16.74	0.00	0.00	0.00	024.774	00.000
10.30	013	306	577	00.73	00.7	0002	0107	0.63	0.00	02.54	00.182	17.86	0.00	0.00	0.00	024.765	00.000
11.00	013	301	560	00.71	00.3	0001	0107	0.57	0.00	02.33	00.276	18.10	0.00	0.00	0.00	024.760	00.000
11.30	013	294	543	00.79	00.0	0000	0107	0.51	0.00	02.21	00.277	15.31	0.00	0.00	0.00	024.746	00.000
12.00	013	277	329	00.72	00.3	0000	0107	0.46	0.00	02.16	00.334	18.33	0.00	0.00	0.00	024.742	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	021	033	00.00	00.0	0000	0000	0.07	0.00	00.00	00.144	20.14	0.00	0.00	0.00	025.326	00.000
00.30	014	040	054	00.24	00.0	0000	0000	0.07	0.00	00.00	00.067	20.10	0.00	0.00	0.00	025.415	00.000
01.00	014	063	091	00.37	00.0	0000	0000	0.08	0.00	00.21	00.074	20.35	0.00	0.00	0.00	025.298	00.000
01.30	014	102	138	00.59	00.3	0000	0000	0.08	0.00	00.30	00.083	20.17	0.00	0.00	0.00	025.237	00.000
02.00	014	131	222	00.54	00.0	0000	0000	0.28	0.00	01.60	00.091	19.44	0.00	0.00	0.00	025.259	00.000
02.30	014	176	289	00.55	00.0	0000	0000	0.09	0.00	02.45	00.09	18.91	0.00	0.00	0.00	025.259	00.000
03.00	014	226	397	00.66	02.1	0004	0000	0.11	0.00	03.63	00.092	18.37	0.00	0.00	0.00	025.275	00.000
03.30	014	231	557	00.72	05.4	0011	0004	0.15	0.00	05.66	00.127	17.21	0.00	0.00	0.00	025.232	00.000
04.00	014	358	675	00.80	04.2	0011	0011	0.22	0.00	07.17	00.233	15.45	0.00	0.00	0.00	025.153	00.000
04.30	014	419	807	00.75	07.1	0019	0019	0.33	0.00	09.45	00.273	13.74	0.00	0.00	0.00	025.094	00.000
05.00	014	423	779	00.74	11.2	0031	0037	0.41	0.00	13.41	00.293	11.64	0.00	0.00	0.00	025.066	00.000
05.30	014	429	880	00.68	12.8	0032	0055	0.45	0.00	13.63	00.342	08.64	0.00	0.00	0.00	025.043	00.000
06.00	014	437	865	00.73	15.4	0045	0072	0.51	0.00	12.81	00.984	08.77	0.00	0.00	0.00	024.855	00.000
06.30	014	441	742	00.71	13.3	0036	0091	0.55	0.00	12.25	00.571	08.65	0.00	0.00	0.00	024.820	00.000
07.00	016	461	734	00.75	02.2	0004	0106	1.32	0.00	11.32	00.072	06.50	0.00	0.00	0.00	000.000	00.000
07.30	016	393	675	00.72	01.3	0003	0106	1.18	0.00	11.39	00.072	05.39	0.00	0.00	0.00	000.000	00.000
08.00	017	258	503	00.72	01.0	0001	0106	1.02	0.00	11.72	00.072	09.15	0.00	0.00	0.00	000.000	00.000
08.30	017	295	325	00.69	00.3	0002	0106	0.92	0.00	11.50	00.072	09.83	0.00	0.00	0.00	000.000	00.000
09.00	018	193	237	00.67	00.7	0000	0106	0.83	0.00	11.28	00.072	11.17	0.00	0.00	0.00	000.000	00.000
09.30	018	188	186	00.69	00.0	0000	0106	0.75	0.00	10.25	00.072	13.07	0.00	0.00	0.00	000.000	00.000
10.00	018	165	169	00.68	00.1	0000	0106	0.59	0.00	07.70	00.072	15.12	0.00	0.00	0.00	000.000	00.000
10.30	018	160	147	00.67	00.2	0000	0106	0.63	0.00	05.51	00.072	16.36	0.00	0.00	0.00	000.000	00.000
11.00	018	155	142	00.63	00.0	0000	0106	0.59	0.00	04.16	00.072	17.65	0.00	0.00	0.00	000.000	00.000

TABLE 18: Medium cribs - 4 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	007	029	036	00.00	00.0	0000	0000	0.08	0.00	00.00	00.083	20.18	0.00	0.00	0.00	001.233	00.000
00.30	007	030	074	00.16	00.1	0000	0000	0.09	0.00	00.00	00.081	20.72	0.00	0.00	0.00	001.251	00.000
01.00	007	042	116	00.30	00.0	0000	0000	0.10	0.00	00.00	00.082	20.50	0.00	0.00	0.00	001.257	00.000
01.30	007	054	261	00.31	00.0	0000	0000	0.11	0.00	00.70	00.093	20.48	0.00	0.00	0.00	001.239	00.000
02.00	007	064	309	00.34	00.0	0000	0000	0.12	0.00	01.24	00.091	20.05	0.00	0.00	0.00	001.206	00.000
02.30	007	073	338	00.38	00.1	0000	0000	0.14	0.00	01.84	00.093	19.51	0.00	0.00	0.00	001.197	00.000
03.00	007	084	397	00.42	00.4	0001	0000	0.17	0.00	02.31	00.098	19.05	0.00	0.00	0.00	001.185	00.000
03.30	007	106	579	00.47	00.9	0001	0000	0.25	0.00	02.67	00.099	18.70	0.00	0.00	0.00	001.101	00.000
04.00	007	132	725	00.54	03.0	0006	0001	0.41	0.00	03.35	00.102	17.98	0.00	0.00	0.00	000.973	00.000
04.30	007	234	769	00.63	02.7	0008	0006	0.56	0.00	05.29	00.107	17.45	0.00	0.00	0.00	000.870	00.000
05.00	007	246	834	00.64	09.1	0027	0022	0.68	0.00	07.18	00.135	15.63	0.00	0.00	0.00	000.789	00.000
05.30	007	259	778	00.74	15.2	0053	0047	0.72	0.00	09.05	00.153	13.63	0.00	0.00	0.00	001.119	00.000
06.00	007	270	800	00.69	11.1	0037	0067	0.73	0.00	11.74	00.299	11.61	0.00	0.00	0.00	000.870	00.000
06.30	007	274	847	00.75	07.8	0022	0081	0.71	0.00	10.98	00.205	09.63	0.00	0.00	0.00	000.900	00.000
07.00	007	282	797	00.69	07.0	0024	0094	0.70	0.00	10.05	00.146	10.50	0.00	0.00	0.00	000.861	00.000
07.30	007	283	722	00.63	02.8	0009	0103	0.62	0.00	09.23	00.132	10.91	0.00	0.00	0.00	000.834	00.000
08.00	007	275	618	00.65	01.7	0005	0107	0.58	0.00	08.25	00.127	11.88	0.00	0.00	0.00	000.774	00.000
08.30	007	256	516	00.63	00.8	0002	0105	0.47	0.00	06.73	00.123	13.04	0.00	0.00	0.00	000.792	00.000
09.00	007	232	461	00.61	00.2	0001	0108	0.41	0.00	04.80	00.117	14.14	0.00	0.00	0.00	000.738	00.000
09.30	007	137	435	00.63	00.5	0001	0108	0.37	0.00	03.40	00.131	15.95	0.00	0.00	0.00	000.798	00.000
10.00	008	133	413	00.61	00.4	0001	0108	0.34	0.00	02.72	00.161	17.31	0.00	0.00	0.00	000.651	00.000
10.30	007	128	398	00.56	00.5	0001	0108	0.33	0.00	02.53	00.194	18.12	0.00	0.00	0.00	000.642	00.000
11.00	007	124	383	00.58	00.4	0001	0108	0.31	0.00	02.38	00.214	18.48	0.00	0.00	0.00	000.702	00.000

TABLE 19: Medium cribs - 4 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	020	013	00.00	00.0	0000	0000	0.06	0.00	00.00	00.000	20.90	0.00	0.00	0.00	001.237	00.000
00.30	013	023	097	00.00	00.4	0000	0000	0.07	0.00	00.00	00.000	20.53	0.00	0.00	0.00	001.168	00.000
01.00	014	039	137	00.10	00.4	0000	0000	0.08	0.00	00.00	00.022	20.85	0.00	0.00	0.00	001.115	00.000
01.30	013	048	169	00.13	00.2	0000	0000	0.10	0.00	00.40	00.095	20.88	0.00	0.00	0.00	001.107	00.000
02.00	012	071	270	00.15	00.3	0000	0000	0.10	0.00	00.79	00.112	20.19	0.00	0.00	0.00	001.095	00.000
02.30	013	106	362	00.30	00.3	0000	0000	0.14	0.00	01.13	00.119	19.57	0.00	0.00	0.00	001.097	00.000
03.00	013	143	457	00.32	00.3	0001	0000	0.20	0.00	02.17	00.134	19.57	0.00	0.00	0.00	001.012	00.000
03.30	012	195	761	00.38	02.5	0004	0000	0.23	0.00	02.96	00.164	18.45	0.00	0.00	0.00	000.930	00.000
04.00	012	244	853	00.41	10.0	0019	0007	0.45	0.00	04.21	00.155	18.03	0.00	0.00	0.00	000.734	00.000
04.30	012	262	795	00.57	11.5	0031	0017	0.70	0.00	06.53	00.183	16.77	0.00	0.00	0.00	000.535	00.000
05.00	012	275	813	00.52	19.7	0049	0036	0.75	0.00	08.43	00.931	14.09	0.00	0.00	0.00	000.214	00.000
05.30	012	273	841	00.56	15.0	0040	0069	0.75	0.00	11.21	01.071	12.59	0.00	0.00	0.00	000.000	00.000
06.00	012	292	824	00.60	26.2	0076	0092	0.75	0.00	10.61	00.536	15.09	0.00	0.00	0.00	000.000	00.000
06.30	013	224	803	00.60	16.7	0049	0121	0.73	0.00	09.72	00.111	10.24	0.00	0.00	0.00	000.000	00.000
07.00	013	293	787	00.51	14.7	0037	0146	0.82	0.00	07.12	00.121	11.36	0.00	0.00	0.00	000.000	00.000
07.30	012	287	776	00.56	11.3	0031	0147	0.73	0.00	09.59	00.152	11.79	0.00	0.00	0.00	000.000	00.000
08.00	012	397	736	00.52	03.7	0010	0176	0.69	0.00	08.09	00.174	12.23	0.00	0.00	0.00	000.000	00.000
08.30	013	304	788	00.47	02.4	0006	0182	0.59	0.00	06.35	00.181	12.73	0.00	0.00	0.00	000.000	00.000
09.00	012	259	694	00.48	01.4	0003	0185	0.54	0.00	05.67	00.179	14.13	0.00	0.00	0.00	000.000	00.000
09.30	013	273	631	00.31	01.1	0003	0185	0.47	0.00	04.37	00.169	15.13	0.00	0.00	0.00	000.000	00.000
10.00	013	255	530	00.55	00.6	0002	0185	0.45	0.00	03.08	00.155	16.73	0.00	0.00	0.00	000.000	00.000
10.30	012	281	555	00.48	00.6	0001	0185	0.44	0.00	02.45	00.185	17.71	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	029	001	00.00	00.0	0000	0000	0.08	0.00	00.00	00.000	21.46	0.00	0.00	0.00	001.204	00.000
00.30	013	041	039	00.00	00.1	0000	0000	0.08	0.00	00.00	00.000	21.48	0.00	0.00	0.00	001.242	00.000
01.00	013	059	065	00.17	00.1	0000	0000	0.06	0.00	00.00	00.000	21.12	0.00	0.00	0.00	001.037	00.000
01.30	013	080	098	00.23	00.1	0000	0000	0.10	0.00	00.69	00.092	20.41	0.00	0.00	0.00	001.153	00.000
02.00	013	104	158	00.24	00.2	0000	0000	0.11	0.00	01.25	00.099	19.76	0.00	0.00	0.00	001.107	00.000
02.30	013	137	205	00.32	00.2	0001	0000	0.13	0.00	01.75	00.146	19.52	0.00	0.00	0.00	001.008	00.000
03.00	013	172	438	00.37	03.3	0005	0000	0.19	0.00	02.74	00.103	18.87	0.00	0.00	0.00	001.000	00.000
03.30	013	215	617	00.44	12.2	0023	0008	0.33	0.00	04.15	00.103	17.70	0.00	0.00	0.00	000.829	00.000
04.00	013	268	749	00.50	08.5	0029	0029	0.47	0.00	06.39	00.152	16.37	0.00	0.00	0.00	000.558	00.000
04.30	013	252	896	00.45	21.4	0047	0044	0.57	0.00	08.33	00.503	14.27	0.00	0.00	0.00	000.449	00.000
05.00	013	261	865	00.55	22.7	0059	0066	0.60	0.00	11.32	00.745	12.17	0.00	0.00	0.00	000.251	00.000
05.30	013	267	980	00.36	18.4	0031	0087	0.62	0.00	11.89	01.062	09.72	0.00	0.00	0.00	000.014	00.000
06.00	013	271	963	00.53	29.3	0051	0111	0.65	0.00	11.92	00.851	08.90	0.00	0.00	0.00	000.000	00.000
06.30	013	273	824	00.55	15.7	0042	0133	0.64	0.00	11.59	00.600	09.38	0.00	0.00	0.00	000.000	00.000
07.00	013	272	815	00.60	22.0	0063	0161	0.60	0.00	11.23	00.433	09.15	0.00	0.00	0.00	000.000	00.000
07.30	013	287	749	00.57	02.2	0006	0172	0.51	0.00	10.23	00.270	09.53	0.00	0.00	0.00	000.000	00.000
08.00	013	278	739	00.58	01.3	0004	0172	0.45	0.00	07.70	00.190	11.17	0.00	0.00	0.00	000.000	00.000
08.30	013	268	683	00.55	01.0	0003	0172	0.41	0.00	05.51	00.137	13.47	0.00	0.00	0.00	000.000	00.000
09.00	013	254	634	00.53	00.3	0001	0172	0.38	0.00	04.16	00.121	15.12	0.00	0.00	0.00	000.000	00.000
09.30	013	274	599	00.53	00.7	0002	0172	0.33	0.00	03.54	00.125	16.56	0.00	0.00	0.00	000.000	00.000
10.00	013	262	577	00.50	00.0	0000	0172	0.33	0.00	03.15	00.147	17.65	0.00	0.00	0.00	000.000	00.000
10.30	013	256	560	00.53	00.1	0000	0172	0.31	0.00	02.75	00.131	18.08	0.00	0.00	0.00	000.000	00.000
11.00	013	247	543	00.50	00.2	0000	0172	0.31	0.00	02.80	00.295	17.93	0.00	0.00	0.00	000.000	00.000

TABLE 20: Large crib - free burning.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m.	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.772	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.331	00.000
01.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.334	00.000
01.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.333	00.000
02.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.290	00.000
02.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.259	00.000
03.00	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.236	00.000
03.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.212	00.000
04.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.179	00.000
04.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.133	00.000
05.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.04	0.04	0.04	002.064	00.000
05.30	000	000	000	00.00	0.01	0000	0000	0.00	0.00	00.00	00.000	00.00	0.05	0.05	0.05	001.997	00.000
06.00	000	000	000	00.00	0.02	0000	0000	0.00	0.00	00.00	00.000	00.00	0.09	0.07	0.08	001.896	00.000
06.30	000	000	000	00.00	0.02	0000	0000	0.00	0.00	00.00	00.000	00.00	0.11	0.11	0.09	001.758	00.000
07.00	000	000	000	00.00	0.05	0000	0000	0.00	0.00	00.00	00.000	00.00	0.15	0.15	0.10	001.640	00.000
07.30	000	000	000	00.00	0.09	0000	0000	0.00	0.00	00.00	00.000	00.00	0.23	0.19	0.16	001.509	00.000
08.00	000	000	000	00.00	0.16	0000	0000	0.00	0.00	00.00	00.000	00.00	0.25	0.27	0.21	001.357	00.000
08.30	000	000	000	00.00	0.22	0000	0000	0.00	0.00	00.00	00.000	00.00	0.31	0.33	0.30	001.139	00.000
09.00	000	000	000	00.00	0.33	0000	0000	0.00	0.00	00.00	00.000	00.00	0.37	0.44	0.36	001.059	00.000
09.30	000	000	000	00.00	0.43	0000	0000	0.00	0.00	00.00	00.000	00.00	0.46	0.51	0.37	000.907	00.000
10.00	000	000	000	00.00	0.64	0000	0000	0.00	0.00	00.00	00.000	00.00	0.53	0.54	0.50	000.786	00.000
10.30	000	000	000	00.00	0.81	0000	0000	0.00	0.00	00.00	00.000	00.00	0.67	0.78	0.53	000.634	00.000
11.00	000	000	000	00.00	1.15	0000	0000	0.00	0.00	00.00	00.000	00.00	0.89	0.71	0.39	000.599	00.000
11.30	000	000	000	00.00	1.37	0000	0000	0.00	0.00	00.00	00.000	00.00	0.93	1.08	0.87	000.523	00.000
12.00	000	000	000	00.00	1.59	0000	0000	0.00	0.00	00.00	00.000	00.00	1.03	1.22	1.04	000.457	00.000
12.30	000	000	000	00.00	1.85	0000	0000	0.00	0.00	00.00	00.000	00.00	1.05	1.23	1.06	000.406	00.000
13.00	000	000	000	00.00	2.07	0000	0000	0.00	0.00	00.00	00.000	00.00	0.98	1.27	1.07	000.352	00.000
13.30	000	000	000	00.00	2.23	0000	0000	0.00	0.00	00.00	00.000	00.00	1.02	1.31	1.07	000.314	00.000
14.00	000	000	000	00.00	2.40	0000	0000	0.00	0.00	00.00	00.000	00.00	1.00	1.27	1.05	000.274	00.000
14.30	000	000	000	00.00	2.51	0000	0000	0.00	0.00	00.00	00.000	00.00	0.96	1.21	1.02	000.237	00.000
15.00	000	000	000	00.00	2.53	0000	0000	0.00	0.00	00.00	00.000	00.00	0.99	1.18	1.03	000.224	00.000
15.30	000	000	000	00.00	2.49	0000	0000	0.00	0.00	00.00	00.000	00.00	0.93	1.29	1.02	000.235	00.000
16.00	000	000	000	00.00	2.42	0000	0000	0.00	0.00	00.00	00.000	00.00	1.00	1.24	1.04	000.134	00.000
16.30	000	000	000	00.00	2.31	0000	0000	0.00	0.00	00.00	00.000	00.00	0.96	1.22	1.03	000.157	00.000
17.00	000	000	000	00.00	2.19	0000	0000	0.00	0.00	00.00	00.000	00.00	0.95	1.23	1.04	000.129	00.000
17.30	000	000	000	00.00	2.11	0000	0000	0.00	0.00	00.00	00.000	00.00	0.99	1.23	1.03	000.107	00.000
18.00	000	000	000	00.00	2.08	0000	0000	0.00	0.00	00.00	00.000	00.00	0.99	1.24	1.04	000.093	00.000
18.30	000	000	000	00.00	2.03	0000	0000	0.00	0.00	00.00	00.000	00.00	1.02	1.26	1.03	000.089	00.000
19.00	000	000	000	00.00	2.04	0000	0000	0.00	0.00	00.00	00.000	00.00	1.03	1.22	1.02	000.071	00.000
19.30	000	000	000	00.00	1.79	0000	0000	0.00	0.00	00.00	00.000	00.00	1.01	1.23	1.01	000.050	00.000
20.00	000	000	000	00.00	1.78	0000	0000	0.00	0.00	00.00	00.000	00.00	1.02	1.22	1.00	000.027	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.339	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.326	00.000
01.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.317	00.000
01.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.311	00.000
02.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.295	00.000
02.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.03	002.277	00.000
03.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.262	00.000
03.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.225	00.000
04.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.01	0.01	0.02	002.132	00.000
04.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.03	0.02	0.06	002.124	00.000
05.00	000	000	000	00.00	0.10	0000	0000	0.00	0.00	00.00	00.000	00.00	0.09	0.09	0.19	002.038	00.000
05.30	000	000	000	00.00	0.14	0000	0000	0.00	0.00	00.00	00.000	00.00	0.23	0.17	0.22	001.915	00.000
06.00	000	000	000	00.00	0.18	0000	0000	0.00	0.00	00.00	00.000	00.00	0.31	0.22	0.24	001.818	00.000
06.30	000	000	000	00.00	0.15	0000	0000	0.00	0.00	00.00	00.000	00.00	0.30	0.27	0.30	001.679	00.000
07.00	000	000	000	00.00	0.15	0000	0000	0.00	0.00	00.00	00.000	00.00	0.33	0.34	0.33	001.589	00.000
07.30	000	000	000	00.00	0.12	0000	0000	0.00	0.00	00.00	00.000	00.00	0.36	0.37	0.37	001.570	00.000
08.00	000	000	000	00.00	0.10	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.42	0.49	[illegible]	00.000
08.30	000	000	000	00.00	0.16	0000	0000	0.00	0.00	00.00	00.000	00.00	0.48	0.49	0.51	001.373	00.000
09.00	000	000	000	00.00	0.13	0000	0000	0.00	0.00	00.00	00.000	00.00	0.52	0.55	0.60	000.962	00.000
09.30	000	000	000	00.00	0.19	0000	0000	0.00	0.00	00.00	00.000	00.00	0.56	0.59	0.66	000.831	00.000
10.00	000	000	000	00.00	0.25	0000	0000	0.00	0.00	00.00	00.000	00.00	0.63	0.66	0.72	000.733	00.000
10.30	000	000	000	00.00	0.34	0000	0000	0.00	0.00	00.00	00.000	00.00	0.70	0.79	0.79	000.610	00.000
11.00	000	000	000	00.00	0.46	0000	0000	0.00	0.00	00.00	00.000	00.00	0.74	0.73	0.85	000.593	00.000
11.30	000	000	000	00.00	0.66	0000	0000	0.00	0.00	00.00	00.000	00.00	0.87	0.79	0.99	000.444	00.000
12.00	000	000	000	00.00	0.73	0000	0000	0.00	0.00	00.00	00.000	00.00	1.02	1.08	1.21	000.386	00.000
12.30	000	000	000	00.00	1.29	0000	0000	0.00	0.00	00.00	00.000	00.00	1.13	1.13	1.37	000.322	00.000
13.00	000	000	000	00.00	1.61	0000	0000	0.00	0.00	00.00	00.000	00.00	1.62	1.63	1.62	000.254	00.000
13.30	000	000	000	00.00	1.73	0000	0000	0.00	0.00	00.00	00.000	00.00	1.76	1.68	1.82	000.218	00.000
14.00	000	000	000	00.00	1.51	0000	0000	0.00	0.00	00.00	00.000	00.00	1.68	1.72	1.72	000.221	00.000
14.30	000	000	000	00.00	1.37	0000	0000	0.00	0.00	00.00	00.000	00.00	1.69	1.64	1.76	000.292	00.000
15.00	000	000	000	00.00	1.34	0000	0000	0.00	0.00	00.00	00.000	00.00	1.57	1.56	1.74	000.169	00.000
15.30	000	000	000	00.00	1.36	0000	0000	0.00	0.00	00.00	00.000	00.00	1.57	1.54	1.73	000.155	00.000
16.00	000	000	000	00.00	1.27	0000	0000	0.00	0.00	00.00	00.000	00.00	1.53	1.51	1.72	000.138	00.000
16.30	000	000	000	00.00	1.22	0000	0000	0.00	0.00	00.00	00.000	00.00	1.53	1.49	1.66	000.117	00.000
17.00	000	000	000	00.00	1.16	0000	0000	0.00	0.00	00.00	00.000	00.00	1.51	1.53	1.65	000.117	00.000
17.30	000	000	000	00.00	1.17	0000	0000	0.00	0.00	00.00	00.000	00.00	1.51	1.51	1.63	000.104	00.000
18.00	000	000	000	00.00	1.14	0000	0000	0.00	0.00	00.00	00.000	00.00	1.51	1.51	1.60	000.074	00.000
18.30	000	000	000	00.00	1.12	0000	0000	0.00	0.00	00.00	00.000	00.00	1.51	1.44	1.57	000.061	00.000
19.00	000	000	000	00.00	1.14	0000	0000	0.00	0.00	00.00	00.000	00.00	1.54	1.47	1.55	000.067	00.000
19.30	000	000	000	00.00	1.11	0000	0000	0.00	0.00	00.00	00.000	00.00	1.52	1.49	1.49	000.049	00.000
20.00	000	000	000	00.00	1.10	0000	0000	0.00	0.00	00.00	00.000	00.00	1.51	1.45	1.46	000.049	00.000

TABLE 21: Large crib - box - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	017	000	015	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.709	00.000
00.30	017	000	023	00.00	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.315	00.000
01.00	017	000	038	00.00	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.315	00.000
01.30	017	000	047	00.00	0.00	0000	0000	0.16	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.326	00.000
02.00	017	000	055	00.00	0.00	0000	0000	0.21	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.334	00.000
02.30	017	000	073	00.00	0.00	0000	0000	0.27	0.00	00.00	00.000	00.00	0.01	0.00	0.00	002.285	00.000
03.00	017	000	119	00.00	0.01	0000	0000	0.33	0.00	00.00	00.000	00.00	0.01	0.01	0.00	002.272	00.000
03.30	017	000	163	00.00	0.02	0000	0000	0.61	0.00	00.00	00.000	00.00	0.02	0.01	0.01	002.217	00.000
04.00	017	000	297	00.00	0.03	0000	0000	0.79	0.00	00.00	00.000	00.00	0.04	0.03	0.02	002.193	00.000
04.30	017	000	403	00.00	0.08	0000	0000	1.42	0.00	00.00	00.000	00.00	0.07	0.07	0.07	002.102	00.000
05.00	017	000	540	00.00	0.14	0000	0000	1.57	0.00	00.00	00.000	00.00	0.13	0.12	0.09	002.016	00.000
05.30	017	000	670	00.00	0.17	0000	0000	2.65	0.00	00.00	00.000	00.00	0.18	0.19	0.17	001.915	00.000
06.00	017	000	668	00.00	0.27	0000	0000	3.15	0.00	00.00	00.000	00.00	0.26	0.31	0.32	001.773	00.000
06.30	017	000	741	00.00	0.40	0000	0000	3.47	0.00	00.00	00.000	00.00	0.41	0.37	0.37	001.647	00.000
07.00	017	000	735	00.00	0.53	0000	0000	3.52	0.00	00.00	00.000	00.00	0.53	0.46	0.48	001.443	00.000
07.30	017	000	774	00.00	0.67	0000	0000	3.24	0.00	00.00	00.000	00.00	0.60	0.53	0.72	001.273	00.000
08.00	017	000	785	00.00	0.85	0000	0000	2.67	0.00	00.00	00.000	00.00	0.73	0.83	0.33	001.009	00.000
08.30	017	000	753	00.00	1.04	0000	0000	1.63	0.00	00.00	00.000	00.00	1.15	1.07	1.06	000.961	00.000
09.00	017	000	782	00.00	1.42	0000	0000	1.09	0.00	00.00	00.000	00.00	1.45	1.34	1.51	000.733	00.000
09.30	017	000	892	00.00	1.65	0000	0000	1.42	0.00	00.00	00.000	00.00	1.31	1.73	1.59	000.638	00.000
10.00	017	000	760	00.00	2.01	0000	0000	1.23	0.00	00.00	00.000	00.00	2.12	2.21	1.76	000.572	00.000
10.30	017	000	711	00.00	2.22	0000	0000	1.36	0.00	00.00	00.000	00.00	2.39	2.50	2.27	000.517	00.000
11.00	018	000	527	00.00	2.18	0000	0000	3.21	0.00	00.00	00.000	00.00	2.47	2.57	2.22	000.504	00.000
11.30	018	000	436	00.00	2.19	0000	0000	3.44	0.00	00.00	00.000	00.00	2.27	2.49	2.23	000.474	00.000
12.00	018	000	353	00.00	2.46	0000	0000	3.18	0.00	00.00	00.000	00.00	2.29	2.61	2.28	000.471	00.000
12.30	017	000	302	00.00	2.34	0000	0000	2.72	0.00	00.00	00.000	00.00	2.32	2.44	2.21	000.445	00.000
13.00	018	000	302	00.00	1.99	0000	0000	2.76	0.00	00.00	00.000	00.00	2.23	2.40	2.12	000.455	00.000
13.30	019	000	307	00.00	1.93	0000	0000	2.66	0.00	00.00	00.000	00.00	2.21	2.39	2.09	000.437	00.000
14.00	018	000	203	00.00	1.72	0000	0000	2.56	0.00	00.00	00.000	00.00	2.19	2.36	2.01	000.435	00.000
14.30	019	000	237	00.00	1.90	0000	0000	2.46	0.00	00.00	00.000	00.00	2.21	2.37	1.99	000.416	00.000
15.00	018	000	281	00.00	1.70	0000	0000	2.28	0.00	00.00	00.000	00.00	2.16	2.33	1.74	000.391	00.000
15.30	019	000	259	00.00	1.37	0000	0000	2.16	0.00	00.00	00.000	00.00	2.16	2.33	1.29	000.259	00.000
16.00	018	000	203	00.00	1.39	0000	0000	1.73	0.00	00.00	00.000	00.00	2.15	2.29	1.35	000.250	00.000
16.30	017	000	184	00.00	1.29	0000	0000	1.82	0.00	00.00	00.000	00.00	2.15	2.27	1.29	000.238	00.000
17.00	017	000	185	00.00	1.67	0000	0000	1.74	0.00	00.00	00.000	00.00	2.13	2.25	1.31	000.229	00.000
17.30	017	000	178	00.00	1.33	0000	0000	1.68	0.00	00.00	00.000	00.00	2.12	2.24	1.86	000.217	00.000
18.00	017	000	178	00.00	1.37	0000	0000	1.60	0.00	00.00	00.000	00.00	2.10	2.24	1.84	000.291	00.000
18.30	017	000	175	00.00	1.27	0000	0000	1.51	0.00	00.00	00.000	00.00	2.1	2.22	1.83	000.192	00.000
19.00	017	000	159	00.00	1.35	0000	0000	1.44	0.00	00.00	00.000	00.00	2.11	2.21	1.83	000.180	00.000
19.30	017	000	155	00.00	1.24	0000	0000	1.34	0.00	00.00	00.000	00.00	2.10	2.13	1.94	000.174	00.000
20.00	017	000	145	00.00	1.33	0000	0000	1.25	0.00	00.00	00.000	00.00	2.39	2.19	1.87	000.165	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	015	000	019	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.358	00.000
00.30	015	000	023	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.335	00.000
01.00	015	000	028	00.00	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.323	00.000
01.30	015	000	037	00.00	0.00	0000	0000	0.18	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.316	00.000
02.00	015	000	045	00.00	0.00	0000	0000	0.26	0.00	00.00	00.000	00.00	0.01	0.01	0.02	002.290	00.000
02.30	015	000	051	00.00	0.01	0000	0000	0.31	0.00	00.00	00.000	00.00	0.01	0.01	0.03	002.275	00.000
03.00	015	000	058	00.00	0.01	0000	0000	0.37	0.00	00.00	00.000	00.00	0.02	0.01	0.04	002.223	00.000
03.30	015	000	066	00.00	0.01	0000	0000	0.51	0.00	00.00	00.000	00.00	0.03	0.01	0.04	002.175	00.000
04.00	015	000	107	00.00	0.02	0000	0000	0.78	0.00	00.00	00.000	00.00	0.04	0.02	0.06	002.134	00.000
04.30	015	000	155	00.00	0.07	0000	0000	1.44	0.00	00.00	00.000	00.00	0.07	0.05	0.08	002.019	00.000
05.00	015	000	274	00.00	0.10	0000	0000	1.99	0.00	00.00	00.000	00.00	0.11	0.10	0.13	001.933	00.000
05.30	015	000	453	00.00	0.19	0000	0000	2.65	0.00	00.00	00.000	00.00	0.21	0.23	0.29	001.792	00.000
06.00	015	000	521	00.00	0.26	0000	0000	3.03	0.00	00.00	00.000	00.00	0.29	0.29	0.30	001.603	00.000
06.30	015	000	659	00.00	0.37	0000	0000	3.33	0.00	00.00	00.000	00.00	0.37	0.37	0.42	001.376	00.000
07.00	016	000	627	00.00	0.52	0000	0000	3.45	0.00	00.00	00.000	00.00	0.53	0.50	0.48	001.22	0.000
07.30	016	000	619	00.00	0.64	0000	0000	3.48	0.00	00.00	00.000	00.00	0.66	0.64	0.67	001.019	00.000
08.00	016	000	631	00.00	0.82	0000	0000	3.13	0.00	00.00	00.000	00.00	0.87	0.83	0.82	000.822	00.000
08.30	016	000	796	00.00	1.05	0000	0000	2.77	0.00	00.00	00.000	00.00	1.14	1.37	1.14	000.666	00.000
09.00	016	000	752	00.00	1.27	0000	0000	1.99	0.00	00.00	00.000	00.00	1.51	1.27	1.52	000.461	00.000
09.30	016	000	719	00.00	1.53	0000	0000	1.54	0.00	00.00	00.000	00.00	1.73	1.63	1.72	000.290	00.000
10.00	016	000	693	00.00	1.89	0000	0000	1.47	0.00	00.00	00.000	00.00	1.93	1.94	2.00	000.152	00.000
10.30	016	000	618	00.00	2.19	0000	0000	2.70	0.00	00.00	00.000	00.00	2.25	2.16	2.19	000.067	00.000
11.00	016	000	509	00.00	2.05	0000	0000	3.46	0.00	00.00	00.000	00.00	2.25	2.16	2.19	000.000	00.000
11.30	016	000	427	00.00	1.99	0000	0000	3.42	0.00	00.00	00.000	00.00	2.22	2.29	2.25	000.000	00.000
12.00	016	000	351	00.00	1.72	0000	0000	3.12	0.00	00.00	00.000	00.00	2.19	2.14	2.00	000.000	00.000
12.30	016	000	325	00.00	1.29	0000	0000	2.89	0.00	00.00	00.000	00.00	2.18	2.09	1.99	000.000	00.000
13.00	016	000	297	00.00	1.87	0000	0000	2.73	0.00	00.00	00.000	00.00	2.32	2.05	1.96	000.000	00.000
13.30	016	000	232	00.00	1.35	0000	0000	2.59	0.00	00.00	00.000	00.00	2.05	2.09	1.86	000.000	00.000
14.00	016	000	260	00.00	1.33	0000	0000	2.48	0.00	00.00	00.000	00.00	2.03	2.10	1.81	000.000	00.000
14.30	016	000	237	00.00	1.36	0000	0000	2.37	0.00	00.00	00.000	00.00	2.00	2.08	1.85	000.000	00.000
15.00	016	000	242	00.00	1.83	0000	0000	2.29	0.00	00.00	00.000	00.00	2.01	2.07	1.85	000.000	00.000

TABLE 22: Large crib - box - 20 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	021	003	019	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.522	00.000
00.30	021	003	039	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.519	00.000
01.00	021	003	073	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.516	00.000
01.30	021	003	096	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.505	00.000
02.00	021	003	163	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.488	00.000
02.30	021	004	207	00.00	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.01	0.02	0.03	002.469	00.000
03.00	021	004	247	00.00	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.02	0.07	0.04	002.416	00.000
03.30	021	004	302	00.00	0.00	0000	0000	0.14	0.00	00.00	00.000	00.00	0.03	0.33	0.05	002.43	00.000
04.00	021	004	360	00.00	0.00	0000	0000	0.21	0.00	00.00	00.000	00.00	0.05	0.45	0.07	002.371	00.000
04.30	021	004	496	00.00	0.03	0000	0000	0.33	0.00	00.00	00.000	00.00	0.11	0.09	0.12	002.301	00.000
05.00	022	004	753	00.00	0.10	0000	0000	0.89	0.00	00.00	00.000	00.00	0.23	0.19	0.23	002.233	00.000
05.30	022	004	906	00.00	0.23	0000	0000	1.44	0.00	00.00	00.000	00.00	0.35	0.36	0.31	002.077	00.000
06.00	023	004	849	00.00	0.27	0000	0000	2.09	0.00	00.00	00.000	00.00	0.46	0.48	0.49	001.948	00.000
06.30	023	005	909	00.00	0.37	0000	0000	2.68	0.00	00.00	00.000	00.00	0.74	0.67	0.69	001.772	00.000
07.00	024	006	992	00.00	0.38	0000	0000	3.07	0.00	00.00	00.000	00.00	0.39	0.77	0.76	001.570	00.000
07.30	025	006	884	00.00	0.42	0000	0000	3.33	0.00	00.00	00.000	00.00	0.82	0.88	0.89	001.422	00.000
08.00	025	006	869	00.00	0.55	0000	0000	3.52	0.00	00.00	00.000	00.00	0.53	0.99	1.06	001.273	00.000
08.30	027	006	891	00.00	0.75	0000	0000	3.49	0.00	00.00	00.000	00.00	1.04	1.26	1.29	001.142	00.000
09.00	027	007	934	00.00	0.97	0000	0000	3.41	0.00	00.00	00.000	00.00	1.31	1.53	1.49	000.994	00.000
09.30	028	007	836	00.00	1.48	0000	0000	3.45	0.00	00.00	00.000	00.00	1.54	1.55	1.39	000.845	00.000
10.00	029	007	899	00.00	2.26	0000	0000	3.52	0.00	00.00	00.000	00.00	2.18	2.53	2.53	000.759	00.000
10.30	030	007	831	00.00	3.03	0000	0000	3.34	0.00	00.00	00.000	00.00	2.50	3.37	3.21	000.672	00.000
11.00	030	007	739	00.00	3.34	0000	0000	2.56	0.00	00.00	00.000	00.00	3.34	3.73	3.39	000.590	00.000
11.30	030	007	722	00.00	3.41	0000	0000	1.39	0.00	00.00	00.000	00.00	3.41	4.30	4.27	000.546	00.000
12.00	029	007	611	00.00	3.32	0000	0000	1.47	0.00	00.00	00.000	00.00	3.15	3.72	4.18	000.515	00.000
12.30	027	007	544	00.00	3.17	0000	0000	1.12	0.00	00.00	00.000	00.00	3.31	3.71	4.17	000.473	00.000
13.00	027	007	490	00.00	3.19	0000	0000	0.97	0.00	00.00	00.000	00.00	3.04	3.62	4.07	000.473	00.000
13.30	027	006	450	00.00	3.10	0000	0000	0.26	0.00	00.00	00.000	00.00	3.12	3.55	3.98	000.462	00.000
14.00	027	006	419	00.00	3.02	0000	0000	0.30	0.00	00.00	00.000	00.00	3.14	3.54	3.76	000.442	00.000
14.30	027	006	411	00.00	3.00	0000	0000	0.70	0.00	00.00	00.000	00.00	3.06	3.53	3.20	000.414	00.000
15.00	027	006	388	00.00	2.91	0000	0000	0.62	0.00	00.00	00.000	00.00	2.79	3.43	3.80	000.379	00.000
15.30	027	006	375	00.00	2.94	0000	0000	0.59	0.00	00.00	00.000	00.00	3.47	3.41	3.77	000.400	00.000
16.00	027	006	364	00.00	2.83	0000	0000	0.53	0.00	00.00	00.000	00.00	3.07	3.42	3.72	000.324	00.000
16.30	027	006	351	00.00	2.82	0000	0000	0.51	0.00	00.00	00.000	00.00	2.97	3.37	3.66	000.358	00.000
17.00	026	006	329	00.00	2.76	0000	0000	0.47	0.00	00.00	00.000	00.00	3.09	3.37	3.62	000.351	00.000
17.30	026	006	324	00.00	2.73	0000	0000	0.43	0.00	00.00	00.000	00.00	3.09	3.35	3.44	000.358	00.000
18.00	026	006	310	00.00	2.70	0000	0000	0.42	0.00	00.00	00.000	00.00	3.06	3.33	3.46	000.330	00.000
18.30	026	006	300	00.00	2.67	0000	0000	0.33	0.00	00.00	00.000	00.00	3.08	3.32	3.43	000.333	00.000
19.00	025	006	279	00.00	2.65	0000	0000	0.41	0.00	00.00	00.000	00.00	3.01	3.27	3.40	000.322	00.000
19.30	026	006	278	00.00	2.62	0000	0000	0.34	0.00	00.00	00.000	00.00	2.99	3.29	3.36	000.311	00.000
20.00	025	006	265	00.00	2.60	0000	0000	0.32	0.00	00.00	00.000	00.00	3.01	3.29	3.34	000.302	00.000

TABLE 23: Large crib - box - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	016	000	020	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.09	002.776	00.000
00.30	016	000	071	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.04	002.737	00.000
01.00	016	000	092	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.04	002.337	00.000
01.30	016	000	129	00.00	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.04	002.374	00.000
02.00	016	000	181	00.00	0.00	0000	0000	0.16	0.00	00.00	00.000	00.00	0.00	0.01	0.04	002.254	00.000
02.30	016	000	264	00.00	0.00	0000	0000	0.22	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.333	00.000
03.00	016	000	331	00.00	0.00	0000	0000	0.33	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.219	00.000
03.30	016	000	421	00.00	0.00	0000	0000	0.51	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.271	00.000
04.00	016	000	532	00.00	0.00	0000	0000	0.78	0.00	00.00	00.000	00.00	0.02	0.01	0.05	002.227	00.000
04.30	016	000	812	00.00	0.00	0000	0000	1.74	0.00	00.00	00.000	00.00	0.04	0.05	0.09	002.163	00.000
05.00	016	000	877	00.00	0.11	0000	0000	3.05	0.00	00.00	00.000	00.00	0.12	0.14	0.23	002.076	00.000
05.30	016	000	816	00.00	0.22	0000	0000	2.95	0.00	00.00	00.000	00.00	0.36	0.41	0.37	001.961	00.000
06.00	017	000	779	00.00	0.15	0000	0000	3.19	0.00	00.00	00.000	00.00	0.34	0.33	0.33	001.249	00.000
06.30	017	000	743	00.00	0.14	0000	0000	3.72	0.00	00.00	00.000	00.00	0.42	0.43	0.43	001.715	00.000
07.00	017	000	745	00.00	0.14	0000	0000	3.57	0.00	00.00	00.000	00.00	0.43	0.53	0.53	001.568	00.000
07.30	017	000	750	00.00	0.09	0000	0000	3.79	0.00	00.00	00.000	00.00	0.57	0.56	0.57	001.449	00.000
08.00	017	000	766	00.00	0.43	0000	0000	3.83	0.00	00.00	00.000	00.00	0.54	0.63	0.67	001.237	00.000
08.30	018	000	777	00.00	0.32	0000	0000	3.73	0.00	00.00	00.000	00.00	0.54	0.68	0.67	001.145	00.000
09.00	018	000	792	00.00	0.01	0000	0000	3.50	0.00	00.00	00.000	00.00	0.62	0.73	0.79	000.995	00.000
09.30	017	000	793	00.00	0.00	0000	0000	3.76	0.00	00.00	00.000	00.00	0.81	0.83	0.87	000.896	00.000
10.00	018	000	819	00.00	0.00	0000	0000	3.57	0.00	00.00	00.000	00.00	0.73	0.89	0.94	000.777	00.000
10.30	018	000	827	00.00	0.09	0000	0000	3.54	0.00	00.00	00.000	00.00	0.76	0.95	1.04	000.673	00.000
11.00	016	000	864	00.00	0.17	0000	0000	3.04	0.00	00.00	00.000	00.00	0.81	1.12	1.13	000.577	00.000
11.30	018	000	875	00.00	0.32	0000	0000	2.17	0.00	00.00	00.000	00.00	0.92	1.29	1.23	000.426	00.000
12.00	017	000	873	00.00	0.45	0000	0000	2.29	0.00	00.00	00.000	00.00	1.09	1.41	1.47	000.423	00.000
12.30	018	000	967	00.00	0.81	0000	0000	2.13	0.00	00.00	00.000	00.00	1.45	1.73	1.80	000.349	00.000
13.00	019	000	937	00.00	1.22	0000	0000	2.10	0.00	00.00	00.000	00.00	1.65	2.15	2.13	000.274	00.000
13.30	018	000	972	00.00	1.52	0000	0000	2.06	0.00	00.00	00.000	00.00	1.72	2.30	2.23	000.237	00.000
14.00	019	000	951	00.00	1.68	0000	0000	2.49	0.00	00.00	00.000	00.00	2.03	2.57	2.56	000.195	00.000
14.30	019	000	897	00.00	1.67	0000	0000	3.11	0.00	00.00	00.000	00.00	2.34	2.46	2.53	000.17	00.000
15.00	019	000	843	00.00	1.36	0000	0000	3.72	0.00	00.00	00.000	00.00	1.99	2.36	2.67	000.123	00.000
15.30	019	000	800	00.00	1.36	0000	0000	3.83	0.00	00.00	00.000	00.00	1.82	2.37	2.58	000.113	00.000
16.00	019	000	759	00.00	1.33	0000	0000	3.73	0.00	00.00	00.000	00.00	1.73	2.34	2.47	000.093	00.000
16.30	019	000	715	00.00	1.25	0000	0000	3.55	0.00	00.00	00.000	00.00	1.74	2.27	2.43	000.033	00.000
17.00	019	000	687	00.00	1.29	0000	0000	3.44	0.00	00.00	00.000	00.00	1.77	2.29	2.42	000.051	00.000
17.30	019	000	663	00.00	1.15	0000	0000	3.23	0.00	00.00	00.000	00.00	1.80	2.23	2.43	000.045	00.000
18.00	019	000	645	00.00	1.11	0000	0000	3.13	0.00	00.00	00.000	00.00	1.80	2.23	2.40	000.016	00.000
18.30	019	000	612	00.00	1.49	0000	0000	2.91	0.00	00.00	00.000	00.00	1.77	2.13	2.36	000.016	00.000
19.00	019	000	574	00.00	1.34	0000	0000	2.57	0.00	00.00	00.000	00.00	1.82	2.19	2.31	000.006	00.000
19.30	019	000	563	00.00	1.34	0000	0000	2.23	0.00	00.00	00.000	00.00	1.77	2.17	2.29	000.003	00.000
20.00	020	000	531	00.00	1.03	0000	0000	2.10	0.00	00.00	00.000	00.00	1.67	2.14	2.27	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	022	000	045	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.727	00.000
00.30	021	000	087	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.733	00.000
01.00	022	000	119	00.00	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.371	00.000
01.30	022	000	192	00.00	0.00	0000	0000	0.23	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.345	00.000
02.00	022	000	273	00.00	0.00	0000	0000	0.23	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.345	00.000
02.30	022	000	329	00.00	0.01	0000	0000	0.42	0.00	00.00	00.000	00.00	0.02	0.01	0.03	002.323	00.000
03.00	022	000	437	00.00	0.01	0000	0000	0.77	0.00	00.00	00.000	00.00	0.03	0.02	0.03	002.231	00.000
03.30	022	000	629	00.00	0.03	0000	0000	1.42	0.00	00.00	00.000	00.00	0.24	0.04	0.05	002.217	00.000
04.00	022	000	931	00.00	0.06	0000	0000	2.53	0.00	00.00	00.000	00.00	0.09	0.09	0.15	002.131	00.000
04.30	022	000	757	00.00	0.33	0000	0000	3.16	0.00	00.00	00.000	00.00	0.37	0.27	0.37	002.022	00.000
05.00	022	000	683	00.00	0.22	0000	0000	3.33	0.00	00.00	00.000	00.00	0.37	0.40	0.35	001.919	00.000
05.30	022	000	678	00.00	0.27	0000	0000	3.73	0.00	00.00	00.000	00.00	0.45	0.45	0.41	001.779	00.000
06.00	023	000	662	00.00	0.27	0000	0000	3.54	0.00	00.00	00.000	00.00	0.53	0.51	0.44	001.612	00.000
06.30	023	000	664	00.00	0.31	0000	0000	3.81	0.00	00.00	00.000	00.00	0.52	0.53	0.57	001.468	00.000
07.00	023	000	686	00.00	0.37	0000	0000	3.50	0.00	00.00	00.000	00.00	0.55	0.59	0.59	001.312	00.000
07.30	024	000	678	00.00	0.41	0000	0000	3.71	0.00	00.00	00.000	00.00	0.58	0.79	0.67	001.236	00.000
08.00	024	000	697	00.00	0.47	0000	0000	3.79	0.00	00.00	00.000	00.00	0.65	0.73	0.73	001.053	00.000
08.30	025	000	701	00.00	0.54	0000	0000	3.52	0.00	00.00	00.000	00.00	0.57	0.65	0.82	000.902	00.000
09.00	025	000	795	00.00	0.69	0000	0000	3.27	0.00	00.00	00.000	00.00	0.79	0.93	0.75	000.803	00.000
09.30	026	000	723	00.00	0.86	0000	0000	2.18	0.00	00.00	00.000	00.00	0.91	1.00	1.10	000.734	00.000
10.00	026	000	723	00.00	1.05	0000	0000	2.62	0.00	00.00	00.000	00.00	1.01	1.29	1.19	000.645	00.000
10.30	025	000	766	00.00	1.31	0000	0000	1.83	0.00	00.00	00.000	00.00	1.11	1.34	1.42	000.547	00.000
11.00	027	000	738	00.00	1.48	0000	0000	1.65	0.00	00.00	00.000	00.00	1.22	1.59	1.68	000.464	00.000
11.30	027	000	785	00.00	1.56	0000	0000	2.44	0.00	00.00	00.000	00.00	1.41	1.79	1.89	000.365	00.000
12.00	027	000	915	00.00	1.79	0000	0000	1.57	0.00	00.00	00.000	00.00	1.73	1.91	1.82	000.326	00.000
12.30	027	000	853	00.00	1.73	0000	0000	2.49	0.00	00.00	00.000	00.00	1.89	2.02	2.20	000.298	00.000
13.00	027	000	819	00.00	2.35	0000	0000	2.99	0.00	00.00	00.000	00.00	1.73	2.06	2.23	000.272	00.000
13.30	027	000	733	00.00	2.07	0000	0000	3.61	0.00	00.00	00.000	00.00	1.80	2.09	2.37	000.246	00.000
14.00	027	000	683	00.00	1.93	0000	0000	3.81	0.00	00.00	00.000	00.00	1.36	2.04	2.28	000.221	00.000
14.30	027	000	649	00.00	1.72	0000	0000	3.74	0.00	00.00	00.000	00.00	1.76	1.73	2.22	000.202	00.000
15.00	027	000	622	00.00	1.35	0000	0000	3.59	0.00	00.00	00.000	00.00	1.72	2.04	2.23	000.192	00.000
15.30	027	000	589	00.00	1.82	0000	0000	3.33	0.00	00.00	00.000	00.00	1.72	1.88	2.15	000.196	00.000
16.00	027	000	558	00.00	1.77	0000	0000	3.10	0.00	00.00	00.000	00.00	1.74	1.89	2.14	000.176	00.000
16.30	027	000	537	00.00	1.73	0000	0000	2.74	0.00	00.00	00.000	00.00	1.67	1.92	2.10	000.160	00.000
17.00	027	000	529	00.00	1.73	0000	0000	2.79	0.00	00.00	00.000	00.00	1.74	1.90	2.02	000.150	00.000
17.30	027	000	504	00.00	1.70	0000	0000	2.54	0.00	00.00	00.000	00.00	1.70	1.72	1.97	000.144	00.000
18.00	027	000	492	00.00	1.67	0000	0000	2.48	0.00	00.00	00.000	00.00	1.79	1.86	1.90	000.134	00.000
18.30	026	000	441	00.00	1.65	0000	0000	2.20	0.00	00.00	00.000	00.00	1.73	1.99	1.93	000.125	00.000
19.00	026	000	428	00.00	1.63	0000	0000	2.30	0.00	00.00	00.000	00.00	1.68	1.58	1.94	000.112	00.000
19.30	026	000	411	00.00	1.61	0000	0000	1.66	0.00	00.00	00.000	00.00	1.63	1.88	1.99	000.135	00.000
20.00	026	000	400	00.00	1.53	0000	0000	1.71	0.00	00.00	00.000	00.00	1.64	1.83	1.96	000.090	00.000

TABLE 24: Large crib - 1 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	020	000	020	00.20	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.237	00.000
00.30	020	007	038	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.174	00.000
01.00	020	001	055	00.24	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.168	00.000
01.30	020	009	071	00.25	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.165	00.000
02.00	020	019	091	00.22	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.162	00.000
02.30	020	075	125	00.37	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.151	00.000
03.00	020	158	165	00.43	0.01	0000	0000	0.13	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.149	00.000
03.30	020	191	218	00.49	0.01	0000	0000	0.14	0.00	00.00	00.000	00.00	0.03	0.02	0.03	002.132	00.000
04.00	020	263	288	00.53	0.02	0000	0000	0.21	0.00	00.00	00.000	00.00	0.03	0.02	0.04	002.107	00.000
04.30	020	301	356	00.56	0.04	0000	0000	0.35	0.00	00.00	00.000	00.00	0.06	0.04	0.06	002.051	00.000
05.00	021	376	415	00.66	0.07	0000	0000	0.69	0.00	00.00	00.000	00.00	0.13	0.08	0.09	001.993	00.000
05.30	021	491	536	00.76	0.14	0000	0000	1.45	0.00	00.00	00.000	00.00	0.22	0.16	0.16	001.884	00.000
06.00	022	472	636	00.73	0.43	0000	0000	2.09	0.00	00.00	00.000	00.00	0.42	0.33	0.48	001.734	00.000
06.30	022	525	717	00.75	0.82	0000	0000	2.69	0.00	00.00	00.000	00.00	0.25	0.66	0.39	001.554	00.000
07.00	022	549	732	00.72	1.21	0000	0000	3.09	0.00	00.00	00.000	00.00	1.29	1.07	1.44	001.387	00.000
07.30	022	589	737	00.73	2.20	0000	0000	3.37	0.00	00.00	00.000	00.00	2.23	1.55	2.07	001.209	00.000
08.00	023	583	731	00.81	2.47	0000	0000	3.53	0.00	00.00	00.000	00.00	2.79	2.23	2.77	001.025	00.000
08.30	023	387	737	00.79	3.51	0000	0000	3.51	0.00	00.00	00.000	00.00	3.01	2.35	3.33	000.857	00.000
09.00	023	283	739	00.84	4.56	0000	0000	3.42	0.00	00.00	00.000	00.00	4.45	3.79	4.53	000.714	00.000
09.30	023	169	733	00.80	4.79	0000	0000	3.47	0.00	00.00	00.000	00.00	5.09	4.96	5.34	000.581	00.000
10.00	023	155	725	00.84	5.55	0000	0000	3.53	0.00	00.00	00.000	00.00	6.19	5.24	5.78	000.489	00.000
10.30	023	149	709	00.66	6.47	0000	0000	3.33	0.00	00.00	00.000	00.00	6.95	5.95	6.51	000.429	00.000
11.00	023	129	677	00.87	6.25	0000	0000	2.57	0.00	00.00	00.000	00.00	6.54	6.25	6.44	000.364	00.000
11.30	023	116	617	00.32	5.53	0000	0000	1.68	0.00	00.00	00.000	00.00	5.75	5.09	5.49	000.337	00.000
12.00	023	113	557	00.91	5.65	0000	0000	1.47	0.00	00.00	00.000	00.00	5.72	5.73	5.69	000.314	00.000
12.30	023	089	591	00.86	5.73	0000	0000	1.12	0.00	00.00	00.000	00.00	6.16	5.73	5.25	000.292	00.000
13.00	023	081	463	00.93	5.23	0000	0000	0.97	0.00	00.00	00.000	00.00	6.09	5.69	5.27	000.272	00.000
13.30	023	074	433	00.86	5.19	0000	0000	0.37	0.00	00.00	00.000	00.00	6.27	5.33	5.18	000.256	00.000
14.00	023	071	417	00.79	5.10	0000	0000	0.80	0.00	00.00	00.000	00.00	6.01	5.51	5.12	000.242	00.000
14.30	023	064	379	00.80	4.93	0000	0000	0.70	0.00	00.00	00.000	00.00	6.04	5.54	5.12	000.228	00.000
15.00	023	062	384	00.79	4.34	0000	0000	0.62	0.00	00.00	00.000	00.00	6.07	5.53	5.19	000.22	00.000
15.30	023	059	363	00.82	4.64	0000	0000	0.59	0.00	00.00	00.000	00.00	6.09	5.38	5.04	000.197	00.000
16.00	023	050	345	00.80	4.71	0000	0000	0.53	0.00	00.00	00.000	00.00	5.76	5.19	4.95	000.183	00.000
16.30	023	051	346	00.70	4.30	0000	0000	0.51	0.00	00.00	00.000	00.00	6.02	5.23	4.97	000.17	00.000
17.00	023	042	333	00.75	4.76	0000	0000	0.47	0.00	00.00	00.000	00.00	6.03	5.24	4.96	000.158	00.000
17.30	023	041	333	00.72	4.78	0000	0000	0.43	0.00	00.00	00.000	00.00	5.99	5.22	5.00	000.150	00.000
18.00	023	037	319	00.72	4.76	0000	0000	0.42	0.00	00.00	00.000	00.00	5.77	5.34	4.79	000.145	00.000
18.30	023	034	324	00.73	4.75	0000	0000	0.38	0.00	00.00	00.000	00.00	5.71	5.36	4.99	000.136	00.000
19.00	022	029	277	00.72	4.35	0000	0000	0.42	0.00	00.00	00.000	00.00	5.71	5.23	4.93	000.131	00.000
19.30	022	026	229	00.73	4.26	0000	0000	0.34	0.00	00.00	00.000	00.00	5.67	5.21	4.84	000.122	00.000
20.00	022	023	285	00.75	4.70	0000	0000	0.32	0.00	00.00	00.000	00.00	5.65	5.14	4.64	000.111	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	020	021	025	00.13	0.00	0000	0000	0.07	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.510	00.000
00.30	020	021	027	00.22	0.00	0000	0000	0.07	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.501	00.000
01.00	021	023	040	00.29	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.493	00.000
01.30	021	046	040	00.32	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.479	00.000
02.00	022	067	047	00.34	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.462	00.000
02.30	022	093	059	00.37	0.00	0000	0000	0.16	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.432	00.000
03.00	023	117	076	00.39	0.00	0000	0000	0.25	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.376	00.000
03.30	023	122	096	00.42	0.01	0000	0000	0.32	0.00	00.00	00.000	00.00	0.01	0.01	0.02	002.345	00.000
04.00	024	159	171	00.51	0.01	0000	0000	0.49	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.340	00.000
04.30	026	165	309	00.55	0.02	0000	0000	0.72	0.00	00.00	00.000	00.00	0.03	0.01	0.03	002.296	00.000
05.00	028	279	363	00.66	0.06	0000	0000	1.13	0.00	00.00	00.000	00.00	0.09	0.04	0.09	002.274	00.000
05.30	029	335	490	00.67	0.14	0000	0000	1.72	0.00	00.00	00.000	00.00	0.16	0.12	0.13	002.197	00.000
06.00	029	444	519	00.69	0.34	0000	0000	2.29	0.00	00.00	00.000	00.00	0.39	0.29	0.33	002.082	00.000
06.30	029	560	633	00.75	0.59	0000	0000	3.02	0.00	00.00	00.000	00.00	0.71	0.52	0.76	001.968	00.000
07.00	029	674	744	00.71	1.19	0000	0000	3.39	0.00	00.00	00.000	00.00	1.07	0.91	0.97	001.837	00.000
07.30	029	696	785	00.79	1.70	0000	0000	3.25	0.00	00.00	00.000	00.00	1.55	1.47	1.67	001.654	00.000
08.00	029	697	769	00.74	2.50	0000	0000	2.72	0.00	00.00	00.000	00.00	2.48	2.32	2.73	001.503	00.000
08.30	030	774	737	00.76	3.25	0000	0000	1.67	0.00	00.00	00.000	00.00	3.11	2.73	2.98	001.331	00.000
09.00	030	777	800	00.81	3.25	0000	0000	1.31	0.00	00.00	00.000	00.00	4.16	3.53	3.32	001.159	00.000
09.30	030	733	795	00.84	4.57	0000	0000	1.13	0.00	00.00	00.000	00.00	4.33	4.51	4.76	001.073	00.000
10.00	030	677	776	00.77	5.40	0000	0000	1.01	0.00	00.00	00.000	00.00	5.32	4.75	5.55	000.964	00.000
10.30	030	648	775	00.77	5.45	0000	0000	0.79	0.00	00.00	00.000	00.00	5.27	5.30	5.73	000.862	00.000
11.00	030	563	708	00.84	6.17	0000	0000	0.79	0.00	00.00	00.000	00.00	5.21	5.44	6.05	000.809	00.000
11.30	029	515	610	00.73	5.32	0000	0000	0.79	0.00	00.00	00.000	00.00	5.79	5.60	5.32	000.823	00.000
12.00	028	375	543	00.75	5.31	0000	0000	0.64	0.00	00.00	00.000	00.00	5.49	5.41	5.67	000.729	00.000
12.30	027	317	484	00.72	5.14	0000	0000	0.54	0.00	00.00	00.000	00.00	5.63	5.29	5.53	000.734	00.000
13.00	027	263	477	00.77	4.93	0000	0000	0.46	0.00	00.00	00.000	00.00	6.03	5.33	5.41	000.734	00.000
13.30	026	224	443	00.77	5.12	0000	0000	0.49	0.00	00.00	00.000	00.00	5.99	5.33	5.30	000.731	00.000
14.00	026	219	411	00.76	4.93	0000	0000	0.36	0.00	00.00	00.000	00.00	6.01	4.72	5.46	000.739	00.000
14.30	025	190	416	00.77	4.86	0000	0000	0.39	0.00	00.00	00.000	00.00	5.70	5.01	5.10	000.750	00.000
15.00	026	197	400	00.79	4.30	0000	0000	0.23	0.00	00.00	00.000	00.00	5.74	5.12	5.14	000.733	00.000
15.30	025	185	390	00.80	4.60	0000	0000	0.23	0.00	00.00	00.000	00.00	5.60	4.65	5.16	000.733	00.000
16.00	025	188	371	00.79	4.63	0000	0000	0.22	0.00	00.00	00.000	00.00	5.61	4.71	5.14	000.750	00.000
16.30	026	184	368	00.81	4.56	0000	0000	0.21	0.00	00.00	00.000	00.00	5.74	4.71	5.02	000.742	00.000
17.00	025	152	344	00.80	4.43	0000	0000	0.19	0.00	00.00	00.000	00.00	5.54	4.70	4.88	000.759	00.000
17.30	025	144	325	00.83	4.47	0000	0000	0.13	0.00	00.00	00.000	00.00	5.51	4.91	4.94	000.750	00.000
18.00	025	149	324	00.80	4.43	0000	0000	0.17	0.00	00.00	00.000	00.00	5.21	4.24	4.76	000.742	00.000
18.30	025	137	304	00.85	4.48	0000	0000	0.15	0.00	00.00	00.000	00.00	5.42	4.74	4.88	000.750	00.000
19.00	025	123	303	00.77	4.46	0000	0000	0.14	0.00	00.00	00.000	00.00	5.43	4.83	4.88	000.750	00.000
19.30	025	119	247	00.77	4.41	0000	0000	0.14	0.00	00.00	00.000	00.00	5.30	4.67	4.89	000.759	00.000
20.00	025	116	238	00.75	4.43	0000	0000	0.13	0.00	00.00	00.000	00.00	5.31	4.74	4.80	000.759	00.000

TABLE 25: Large crib - 1 m corridor - 20 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	017	055	020	00.16	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.249	00.000
00.30	017	060	025	00.22	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.229	00.000
01.00	017	061	024	00.23	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.235	00.000
01.30	017	067	031	00.27	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.03	002.222	00.000
02.00	017	078	053	00.30	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.01	0.00	0.03	002.216	00.000
02.30	017	087	080	00.35	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.203	00.000
03.00	017	102	116	00.38	0.00	0000	0000	0.15	0.00	00.00	00.000	00.00	0.02	0.01	0.04	002.161	00.000
03.30	017	111	160	00.41	0.00	0000	0000	0.17	0.00	00.00	00.000	00.00	0.03	0.02	0.05	002.125	00.000
04.00	017	125	234	00.46	0.01	0000	0000	0.26	0.00	00.00	00.000	00.00	0.03	0.03	0.06	002.092	00.000
04.30	017	135	374	00.50	0.05	0000	0000	0.94	0.00	00.00	00.000	00.00	0.20	0.06	0.18	002.021	00.000
05.00	017	150	480	00.50	0.23	0000	0000	1.75	0.00	00.00	00.000	00.00	0.33	0.25	0.40	001.919	00.000
05.30	017	190	550	00.50	0.41	0000	0000	2.49	0.00	00.00	00.000	00.00	0.50	0.47	0.48	001.774	00.000
06.00	019	219	577	00.49	0.60	0000	0000	3.26	0.00	00.00	00.000	00.00	0.76	0.73	0.87	001.612	00.000
06.30	018	225	655	00.49	1.06	0000	0000	3.57	0.00	00.00	00.000	00.00	1.30	1.05	1.42	001.452	00.000
07.00	019	273	697	00.50	1.47	0000	0000	3.88	0.00	00.00	00.000	00.00	1.71	1.46	1.96	001.270	00.000
07.30	019	295	738	00.57	1.68	0000	0000	3.78	0.00	00.00	00.000	00.00	1.94	1.60	2.17	001.092	00.000
08.00	019	363	742	00.54	2.02	0000	0000	3.55	0.00	00.00	00.000	00.00	2.36	2.25	2.77	000.936	00.000
08.30	019	444	703	00.52	2.27	0000	0000	3.18	0.00	00.00	00.000	00.00	2.93	2.93	2.97	000.734	00.000
09.00	020	509	712	00.53	2.96	0000	0000	3.16	0.00	00.00	00.000	00.00	3.18	3.21	3.62	000.634	00.000
09.30	021	575	717	00.58	3.52	0000	0000	3.12	0.00	00.00	00.000	00.00	3.37	3.84	4.19	000.484	00.000
10.00	021	652	641	00.60	4.16	0000	0000	2.99	0.00	00.00	00.000	00.00	4.11	4.69	4.76	000.387	00.000
10.30	021	658	590	00.59	4.68	0000	0000	3.60	0.00	00.00	00.000	00.00	4.33	5.43	5.66	000.318	00.000
11.00	021	632	539	00.64	4.74	0000	0000	3.37	0.00	00.00	00.000	00.00	4.37	5.41	6.36	000.250	00.000
11.30	021	558	506	00.57	5.08	0000	0000	3.64	0.00	00.00	00.000	00.00	4.77	5.51	6.51	000.205	00.000
12.00	021	491	457	00.59	4.73	0000	0000	2.35	0.00	00.00	00.000	00.00	4.79	5.33	6.16	000.195	00.000
12.30	020	438	373	00.60	4.67	0000	0000	2.21	0.00	00.00	00.000	00.00	4.79	5.46	5.79	000.192	00.000
13.00	021	384	337	00.62	4.54	0000	0000	1.20	0.00	00.00	00.000	00.00	4.54	5.33	5.33	000.162	00.000
13.30	021	334	334	00.64	4.53	0000	0000	1.59	0.00	00.00	00.000	00.00	4.55	5.37	5.64	000.143	00.000
14.00	022	329	338	00.69	4.47	0000	0000	1.37	0.00	00.00	00.000	00.00	4.95	5.37	5.53	000.138	00.000
14.30	022	301	333	00.68	4.54	0000	0000	1.33	0.00	00.00	00.000	00.00	4.82	5.49	5.57	000.124	00.000
15.00	022	291	320	00.67	4.16	0000	0000	1.15	0.00	00.00	00.000	00.00	4.84	5.16	5.66	000.101	00.000
15.30	022	259	308	00.72	4.33	0000	0000	1.28	0.00	00.00	00.000	00.00	4.25	5.28	5.51	000.091	00.000
16.00	021	272	313	00.71	4.07	0000	0000	1.91	0.00	00.00	00.000	00.00	4.79	5.39	5.34	000.079	00.000
16.30	022	259	307	00.71	4.08	0000	0000	0.72	0.00	00.00	00.000	00.00	4.67	5.13	5.31	000.065	00.000
17.00	022	237	292	00.70	4.00	0000	0000	0.33	0.00	00.00	00.000	00.00	4.99	5.33	5.32	000.044	00.000
17.30	021	207	270	00.72	4.19	0000	0000	0.32	0.00	00.00	00.000	00.00	4.97	5.10	5.24	000.042	00.000
18.00	021	190	230	00.72	4.03	0000	0000	0.77	0.00	00.00	00.000	00.00	4.71	5.14	5.21	000.029	00.000
18.30	021	178	265	00.72	4.08	0000	0000	0.69	0.00	00.00	00.000	00.00	4.90	5.13	5.14	000.019	00.000
19.00	021	169	252	00.72	3.99	0000	0000	0.70	0.00	00.00	00.000	00.00	4.54	5.97	5.16	000.010	00.000
19.30	021	140	234	00.71	3.76	0000	0000	0.65	0.00	00.00	00.000	00.00	4.48	4.67	5.09	000.000	00.000
20.00	021	153	249	00.72	3.93	0000	0000	0.66	0.00	00.00	00.000	00.00	4.37	5.03	5.03	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	015	047	057	00.38	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.448	00.000
00.30	016	055	078	00.37	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.442	00.000
01.00	016	063	091	00.37	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.03	002.442	00.000
01.30	016	079	107	00.37	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.03	002.437	00.000
02.00	016	087	136	00.40	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.04	002.427	00.000
02.30	016	107	182	00.38	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.01	0.04	002.415	00.000
03.00	016	133	225	00.40	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.00	0.01	0.05	002.409	00.000
03.30	016	154	283	00.44	0.00	0000	0000	0.16	0.00	00.00	00.000	00.00	0.00	0.01	0.05	002.370	00.000
04.00	016	179	316	00.49	0.00	0000	0000	0.17	0.00	00.00	00.000	00.00	0.00	0.01	0.06	002.375	00.000
04.30	016	188	333	00.48	0.00	0000	0000	0.19	0.00	00.00	00.000	00.00	0.00	0.02	0.07	002.348	00.000
05.00	017	222	433	00.52	0.00	0000	0000	0.23	0.00	00.00	00.000	00.00	0.00	0.02	0.08	002.320	00.000
05.30	016	275	497	00.53	0.00	0000	0000	0.33	0.00	00.00	00.000	00.00	0.01	0.02	0.09	002.247	00.000
06.00	017	360	712	00.53	0.03	0000	0000	1.06	0.00	00.00	00.000	00.00	0.08	0.07	0.21	002.159	00.000
06.30	017	470	929	00.53	0.32	0000	0000	2.03	0.00	00.00	00.000	00.00	0.37	0.23	0.38	002.055	00.000
07.00	017	642	790	00.52	0.43	0000	0000	2.79	0.00	00.00	00.000	00.00	0.47	0.45	0.69	001.939	00.000
07.30	017	652	778	00.55	0.61	0000	0000	3.61	0.00	00.00	00.000	00.00	0.60	0.61	0.91	001.814	00.000
08.00	017	797	771	00.58	1.11	0000	0000	3.34	0.00	00.00	00.000	00.00	0.77	0.91	1.24	001.603	00.000
08.30	018	724	795	00.54	1.36	0000	0000	3.66	0.00	00.00	00.000	00.00	1.43	1.29	1.61	001.512	00.000
09.00	018	763	795	00.54	1.87	0000	0000	3.30	0.00	00.00	00.000	00.00	1.80	1.69	2.11	001.375	00.000
09.30	019	763	817	00.53	2.00	0000	0000	3.12	0.00	00.00	00.000	00.00	1.93	2.19	2.46	001.297	00.000
10.00	019	779	628	00.57	2.48	0000	0000	2.07	0.00	00.00	00.000	00.00	2.61	2.46	3.04	001.085	00.000
10.30	019	893	832	00.60	2.90	0000	0000	0.53	0.00	00.00	00.000	00.00	2.87	3.10	3.25	000.964	00.000
11.00	019	770	879	00.62	3.58	0000	0000	1.06	0.00	00.00	00.000	00.00	3.49	3.73	4.38	000.849	00.000
11.30	020	726	916	00.62	4.44	0000	0000	2.17	0.00	00.00	00.000	00.00	4.07	4.27	4.94	000.765	00.000
12.00	020	676	981	00.65	4.49	0000	0000	2.43	0.00	00.00	00.000	00.00	4.99	5.23	5.52	000.686	00.000
12.30	020	633	955	00.57	5.09	0000	0000	3.55	0.00	00.00	00.000	00.00	4.57	5.40	6.12	000.646	00.000
13.00	020	591	924	00.65	5.02	0000	0000	3.38	0.00	00.00	00.000	00.00	5.12	5.52	6.18	000.599	00.000
13.30	020	552	894	00.70	5.32	0000	0000	3.64	0.00	00.00	00.000	00.00	5.21	5.81	6.31	000.531	00.000
14.00	020	515	652	00.74	5.47	0000	0000	3.19	0.00	00.00	00.000	00.00	5.27	5.69	6.02	000.500	00.000
14.30	020	474	790	00.74	5.29	0000	0000	2.77	0.00	00.00	00.000	00.00	5.26	5.79	6.19	000.479	00.000
15.00	020	436	719	00.67	5.14	0000	0000	2.33	0.00	00.00	00.000	00.00	5.34	5.73	6.24	000.457	00.000
15.30	020	419	660	00.75	5.05	0000	0000	1.39	0.00	00.00	00.000	00.00	4.91	5.76	6.34	000.445	00.000
16.00	020	372	636	00.78	4.91	0000	0000	1.73	0.00	00.00	00.000	00.00	4.67	5.53	5.73	000.436	00.000
16.30	020	375	617	00.71	4.87	0000	0000	1.53	0.00	00.00	00.000	00.00	5.05	5.41	5.25	000.418	00.000
17.00	020	364	581	00.74	4.63	0000	0000	1.56	0.00	00.00	00.000	00.00	4.79	5.56	5.35	000.446	00.000
17.30	020	331	568	00.76	4.76	0000	0000	1.42	0.00	00.00	00.000	00.00	4.74	5.53	5.74	000.373	00.000
18.00	020	345	533	00.74	4.81	0000	0000	1.27	0.00	00.00	00.000	00.00	4.77	5.33	5.53	000.378	00.000
18.30	020	337	541	00.72	4.73	0000	0000	1.24	0.00	00.00	00.000	00.00	4.74	5.36	5.62	000.372	00.000
19.00	020	334	533	00.73	4.63	0000	0000	1.18	0.00	00.00	00.000	00.00	4.76	5.26	5.55	000.363	00.000
19.30	020	331	530	00.71	4.57	0000	0000	1.10	0.00	00.00	00.000	00.00	4.75	5.14	5.48	000.351	00.000
20.00	020	316	517	00.67	4.58	0000	0000	1.05	0.00	00.00	00.000	00.00	4.75	5.11	5.37	000.332	00.000

TABLE 26: Large crib - 1 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	059	070	00.33	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.377	00.000
00.30	019	081	146	00.35	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.317	00.000
01.00	019	107	234	00.37	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.302	00.000
01.30	019	135	334	00.38	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.297	00.000
02.00	018	159	431	00.38	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.01	0.01	0.01	002.256	00.000
02.30	018	193	591	00.37	0.01	0000	0000	0.17	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.242	00.000
03.00	013	275	766	00.39	0.02	0000	0000	0.25	0.00	00.00	00.000	00.00	0.03	0.02	0.05	002.197	00.000
03.30	018	332	756	00.37	0.30	0000	0000	0.59	0.00	00.00	00.000	00.00	0.14	0.08	0.14	002.121	00.000
04.00	018	531	688	00.41	0.32	0000	0000	1.23	0.00	00.00	00.000	00.00	0.28	0.31	0.33	002.022	00.000
04.30	013	634	695	00.41	0.32	0000	0000	1.29	0.00	00.00	00.000	00.00	0.37	0.28	0.37	001.929	00.000
05.00	019	726	677	00.39	0.39	0000	0000	2.46	0.00	00.00	00.000	00.00	0.47	0.39	0.45	001.793	00.000
05.30	019	763	693	00.37	0.49	0000	0000	3.41	0.00	00.00	00.000	00.00	0.61	0.54	0.76	001.667	00.000
06.00	019	750	713	00.33	0.72	0000	0000	3.65	0.00	00.00	00.000	00.00	0.90	0.73	0.98	001.547	00.000
06.30	020	772	727	00.37	0.97	0000	0000	3.73	0.00	00.00	00.000	00.00	1.13	1.01	1.44	001.411	00.000
07.00	020	819	749	00.40	1.42	0000	0000	3.59	0.00	00.00	00.000	00.00	1.45	1.33	1.76	001.288	00.000
07.30	021	819	767	00.39	1.69	0000	0000	3.81	0.00	00.00	00.000	00.00	1.75	1.69	2.17	001.152	00.000
08.00	021	850	773	00.33	2.30	0000	0000	2.31	0.00	00.00	00.000	00.00	2.12	2.16	2.71	001.044	00.000
08.30	022	852	789	00.33	2.53	0000	0000	2.41	0.00	00.00	00.000	00.00	2.55	2.53	3.22	000.900	00.000
09.00	023	835	773	00.41	2.72	0000	0000	2.93	0.00	00.00	00.000	00.00	3.02	2.87	3.57	000.806	00.000
09.30	024	808	788	00.44	3.02	0000	0000	2.76	0.00	00.00	00.000	00.00	3.12	3.21	3.69	000.797	00.000
10.00	024	774	796	00.42	3.21	0000	0000	3.14	0.00	00.00	00.000	00.00	3.22	3.37	4.04	000.647	00.000
10.30	025	808	774	00.39	3.23	0000	0000	3.13	0.00	00.00	00.000	00.00	3.57	3.74	4.33	000.572	00.000
11.00	025	813	806	00.40	3.72	0000	0000	2.99	0.00	00.00	00.000	00.00	3.59	4.31	4.39	000.5	00.000
11.30	025	780	835	00.45	4.34	0000	0000	3.47	0.00	00.00	00.000	00.00	4.08	4.71	5.27	000.424	00.000
12.00	026	759	853	00.50	4.59	0000	0000	3.72	0.00	00.00	00.000	00.00	4.58	5.01	5.61	000.373	00.000
12.30	027	659	862	00.48	4.64	0000	0000	3.72	0.00	00.00	00.000	00.00	4.66	5.15	5.83	000.340	00.000
13.00	027	557	889	00.54	4.79	0000	0000	2.99	0.00	00.00	00.000	00.00	4.67	5.44	6.01	000.310	00.000
13.30	027	502	859	00.53	4.88	0000	0000	2.33	0.00	00.00	00.000	00.00	4.26	5.49	6.35	000.239	00.000
14.00	026	467	855	00.53	4.71	0000	0000	1.93	0.00	00.00	00.000	00.00	4.55	5.25	5.83	000.292	00.000
14.30	027	439	827	00.58	4.66	0000	0000	1.74	0.00	00.00	00.000	00.00	4.67	5.29	5.73	000.268	00.000
15.00	025	420	797	00.56	4.56	0000	0000	1.44	0.00	00.00	00.000	00.00	4.32	5.29	5.53	000.259	00.000
15.30	025	400	772	00.56	4.59	0000	0000	1.35	0.00	00.00	00.000	00.00	4.27	5.02	5.52	000.235	00.000
16.00	025	329	754	00.59	4.26	0000	0000	1.21	0.00	00.00	00.000	00.00	4.51	5.40	5.51	000.214	00.000
16.30	025	384	742	00.57	4.21	0000	0000	1.01	0.00	00.00	00.000	00.00	4.75	4.33	5.42	000.235	00.000
17.00	025	363	713	00.60	4.17	0000	0000	0.97	0.00	00.00	00.000	00.00	4.71	5.01	5.33	000.100	00.000
17.30	025	362	694	00.61	4.18	0000	0000	0.86	0.00	00.00	00.000	00.00	4.66	4.30	5.24	000.154	00.000
18.00	025	331	680	00.61	4.15	0000	0000	0.77	0.00	00.00	00.000	00.00	4.60	4.39	5.20	000.153	00.000
18.30	025	326	662	00.53	4.19	0000	0000	0.75	0.00	00.00	00.000	00.00	4.55	4.30	4.96	000.147	00.000
19.00	025	327	653	00.53	4.34	0000	0000	0.73	0.00	00.00	00.000	00.00	4.55	4.36	5.01	000.141	00.000
19.30	024	323	646	00.61	3.97	0000	0000	0.65	0.00	00.00	00.000	00.00	4.51	4.30	4.93	000.129	00.000
20.00	024	321	637	00.60	3.76	0000	0000	0.58	0.00	00.00	00.000	00.00	4.52	4.30	4.94	000.109	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	021	025	072	00.35	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.377	00.000
00.30	021	035	153	00.30	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.350	00.000
01.00	021	052	199	00.33	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.312	00.000
01.30	021	075	251	00.33	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.312	00.000
02.00	021	092	330	00.34	0.00	0000	0000	0.14	0.00	00.00	00.000	00.00	0.01	0.00	0.04	002.278	00.000
02.30	021	159	529	00.37	0.00	0000	0000	0.16	0.00	00.00	00.000	00.00	0.02	0.00	0.05	002.249	00.000
03.00	021	241	823	00.39	0.09	0000	0000	0.29	0.00	00.00	00.000	00.00	0.11	0.46	0.15	002.159	00.000
03.30	021	362	952	00.37	0.46	0000	0000	0.79	0.00	00.00	00.000	00.00	0.57	0.97	0.79	002.123	00.000
04.00	021	459	772	00.40	0.75	0000	0000	1.22	0.00	00.00	00.000	00.00	0.73	0.63	0.68	002.012	00.000
04.30	022	482	782	00.37	0.57	0000	0000	1.61	0.00	00.00	00.000	00.00	0.64	0.72	0.74	001.916	00.000
05.00	022	551	755	00.36	0.66	0000	0000	2.14	0.00	00.00	00.000	00.00	0.84	0.77	0.93	001.794	00.000
05.30	022	623	773	00.37	0.79	0000	0000	2.70	0.00	00.00	00.000	00.00	0.74	0.93	1.08	001.667	00.000
06.00	023	668	799	00.37	1.08	0000	0000	3.12	0.00	00.00	00.000	00.00	1.14	1.13	1.33	001.542	00.000
06.30	023	709	821	00.38	1.24	0000	0000	3.45	0.00	00.00	00.000	00.00	1.60	1.53	1.53	001.425	00.000
07.00	024	743	922	00.36	1.65	0000	0000	3.53	0.00	00.00	00.000	00.00	1.90	2.00	2.13	001.234	00.000
07.30	024	753	772	00.35	2.14	0000	0000	3.53	0.00	00.00	00.000	00.00	2.37	2.47	2.60	001.155	00.000
08.00	025	799	782	00.35	2.54	0000	0000	3.30	0.00	00.00	00.000	00.00	2.79	2.97	3.15	001.020	00.000
08.30	026	751	793	00.38	3.20	0000	0000	3.86	0.00	00.00	00.000	00.00	3.12	3.54	3.84	000.900	00.000
09.00	027	800	813	00.43	3.88	0000	0000	3.00	0.00	00.00	00.000	00.00	3.67	3.75	4.46	000.726	00.000
09.30	027	773	836	00.42	4.21	0000	0000	2.77	0.00	00.00	00.000	00.00	4.14	4.45	4.53	000.675	00.000
10.00	023	732	863	00.41	4.15	0000	0000	3.04	0.00	00.00	00.000	00.00	4.51	5.03	5.24	000.612	00.000
10.30	027	724	899	00.41	4.50	0000	0000	3.17	0.00	00.00	00.000	00.00	4.96	5.65	5.64	000.519	00.000
11.00	029	654	968	00.41	5.14	0000	0000	3.48	0.00	00.00	00.000	00.00	5.88	6.30	6.49	000.444	00.000
11.30	030	570	923	00.42	5.22	0000	0000	3.57	0.00	00.00	00.000	00.00	5.35	6.23	6.23	000.379	00.000
12.00	030	539	939	00.42	5.79	0000	0000	3.30	0.00	00.00	00.000	00.00	5.79	6.51	6.68	000.357	00.000
12.30	031	496	979	00.50	5.57	0000	0000	2.65	0.00	00.00	00.000	00.00	5.70	6.71	6.74	000.324	00.000
13.00	031	442	953	00.59	5.74	0000	0000	2.05	0.00	00.00	00.000	00.00	5.83	6.62	6.88	000.300	00.000
13.30	031	371	949	00.50	5.41	0000	0000	1.67	0.00	00.00	00.000	00.00	5.49	6.51	6.79	000.285	00.000
14.00	031	400	975	00.51	5.46	0000	0000	1.43	0.00	00.00	00.000	00.00	5.13	6.36	6.34	000.273	00.000
14.30	031	379	944	00.49	5.02	0000	0000	1.24	0.00	00.00	00.000	00.00	5.42	6.33	6.07	000.255	00.000
15.00	031	360	911	00.51	4.78	0000	0000	1.12	0.00	00.00	00.000	00.00	5.27	6.10	6.02	000.237	00.000
15.30	031	349	871	00.52	5.01	0000	0000	0.79	0.00	00.00	00.000	00.00	5.23	6.10	5.34	000.237	00.000
16.00	031	340	834	00.51	4.75	0000	0000	0.89	0.00	00.00	00.000	00.00	5.21	6.28	5.70	000.223	00.000
16.30	031	321	811	00.52	4.97	0000	0000	0.81	0.00	00.00	00.000	00.00	5.49	6.18	5.73	000.213	00.000
17.00	030	305	778	00.59	4.73	0000	0000	0.74	0.00	00.00	00.000	00.00	5.46	6.15	5.77	000.174	00.000
17.30	030	310	756	00.52	4.82	0000	0000	0.70	0.00	00.00	00.000	00.00	5.52	6.01	5.57	000.171	00.000
18.00	030	293	735	00.50	4.79	0000	0000	0.64	0.00	00.00	00.000	00.00	5.42	5.92	5.63	000.152	00.000
18.30	030	294	720	00.52	4.71	0000	0000	0.61	0.00	00.00	00.000	00.00	5.37	5.97	5.49	000.127	00.000
19.00	029	271	703	00.52	4.65	0000	0000	0.57	0.00	00.00	00.000	00.00	5.23	5.72	5.59	000.114	00.000
19.30	029	294	691	00.53	4.68	0000	0000	0.54	0.00	00.00	00.000	00.00	5.21	5.77	5.68	000.095	00.000
20.00	023	291	666	00.54	4.60	0000	0000	0.51	0.00	00.00	00.000	00.00	5.23	5.69	5.74	000.087	00.000

TABLE 27: Large crib - 2 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	024	060	027	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.332	00.000
00.30	024	066	026	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.328	00.000
01.00	024	067	045	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.289	00.000
01.30	024	073	057	00.25	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.281	00.000
02.00	024	085	080	00.23	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.277	00.000
02.30	024	096	127	00.33	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.277	00.000
03.00	024	111	192	00.44	0.01	0000	0000	0.10	0.00	00.00	00.000	00.00	0.03	0.02	0.03	002.269	00.000
03.30	024	122	234	00.44	0.03	0000	0000	0.12	0.00	00.00	00.000	00.00	0.05	0.02	0.05	002.243	00.000
04.00	024	137	311	00.47	0.04	0000	0000	0.13	0.00	00.00	00.000	00.00	0.07	0.03	0.09	002.206	00.000
04.30	024	149	407	00.55	0.07	0000	0000	0.14	0.00	00.00	00.000	00.00	0.10	0.06	0.10	002.133	00.000
05.00	024	164	472	00.59	0.11	0000	0000	0.19	0.00	00.00	00.000	00.00	0.23	0.13	0.26	002.019	00.000
05.30	024	208	526	00.63	0.31	0000	0000	0.33	0.00	00.00	00.000	00.00	0.38	0.23	0.37	001.353	00.000
06.00	024	250	541	00.65	0.55	0000	0000	0.51	0.00	00.00	00.000	00.00	0.77	0.48	0.71	001.566	00.000
06.30	025	292	592	00.65	1.07	0000	0000	0.75	0.00	00.00	00.000	00.00	1.22	0.37	1.38	001.442	00.000
07.00	025	313	609	00.55	1.72	0000	0000	0.94	0.00	00.00	00.000	00.00	2.03	1.43	2.17	001.254	00.000
07.30	025	328	634	00.58	2.55	0000	0000	1.04	0.00	00.00	00.000	00.00	2.73	2.13	3.24	001.003	00.000
08.00	026	378	651	00.72	3.75	0000	0000	1.31	0.00	00.00	00.000	00.00	4.22	3.52	4.71	000.775	00.000
08.30	026	485	643	00.73	5.23	0000	0000	1.50	0.00	00.00	00.000	00.00	4.76	4.15	4.95	000.765	00.000
09.00	026	563	634	00.82	5.76	0000	0000	2.02	0.00	00.00	00.000	00.00	5.73	5.27	5.87	000.637	00.000
09.30	027	514	651	00.77	6.77	0000	0000	1.67	0.00	00.00	00.000	00.00	6.41	6.48	6.15	000.525	00.000
10.00	028	509	648	00.80	7.45	0000	0000	1.47	0.00	00.00	00.000	00.00	7.14	6.85	6.83	000.464	00.000
10.30	028	480	644	00.75	6.70	0000	0000	1.33	0.00	00.00	00.000	00.00	7.44	7.07	6.36	000.403	00.000
11.00	028	400	678	00.80	6.45	0000	0000	1.17	0.00	00.00	00.000	00.00	7.14	6.73	6.56	000.336	00.000
11.30	028	318	624	00.77	6.49	0000	0000	1.01	0.00	00.00	00.000	00.00	7.34	7.01	6.21	000.275	00.000
12.00	028	287	563	00.59	6.37	0000	0000	0.34	0.00	00.00	00.000	00.00	7.57	6.56	6.79	000.259	00.000
12.30	028	276	530	00.77	6.30	0000	0000	0.75	0.00	00.00	00.000	00.00	7.23	6.78	6.84	000.230	00.000
13.00	027	255	511	00.73	5.23	0000	0000	0.65	0.00	00.00	00.000	00.00	7.61	6.23	7.30	000.212	00.000
13.30	023	244	476	00.79	5.94	0000	0000	0.58	0.00	00.00	00.000	00.00	7.72	6.40	7.42	000.198	00.000
14.00	028	233	466	00.82	5.77	0000	0000	0.52	0.00	00.00	00.000	00.00	7.47	5.77	7.19	000.201	00.000
14.30	028	231	457	00.71	5.65	0000	0000	0.48	0.00	00.00	00.000	00.00	7.25	6.10	7.30	000.177	00.000
15.00	028	223	445	00.76	5.49	0000	0000	0.41	0.00	00.00	00.000	00.00	7.14	6.20	6.99	[illegible]	00.000
15.30	027	225	449	00.68	5.38	0000	0000	0.37	0.00	00.00	00.000	00.00	7.26	6.21	6.27	000.120	00.000
16.00	028	213	423	00.73	5.30	0000	0000	0.24	0.00	00.00	00.000	00.00	6.67	6.01	6.71	000.125	00.000
16.30	029	205	415	00.77	5.74	0000	0000	0.30	0.00	00.00	00.000	00.00	6.51	6.01	6.36	000.132	00.000
17.00	027	199	401	00.71	5.67	0000	0000	0.23	0.00	00.00	00.000	00.00	6.74	6.01	6.26	000.132	00.000
17.30	027	191	375	00.72	5.67	0000	0000	0.26	0.00	00.00	00.000	00.00	6.66	5.37	6.30	000.066	00.000
18.00	027	175	385	00.67	5.52	0000	0000	0.24	0.00	00.00	00.000	00.00	6.55	5.72	6.15	000.075	00.000
18.30	027	166	369	00.68	5.53	0000	0000	0.22	0.00	00.00	00.000	00.00	6.50	5.38	6.10	[illegible]	00.000
19.00	027	156	367	00.66	5.51	0000	0000	0.20	0.00	00.00	00.000	00.00	6.45	5.73	6.01	000.055	00.000
19.30	027	150	334	00.68	5.53	0000	0000	0.20	0.00	00.00	00.000	00.00	6.35	5.33	5.70	000.047	00.000
20.00	027	144	346	00.63	5.55	0000	0000	0.19	0.00	00.00	00.000	00.00	6.27	5.36	5.72	000.031	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	020	003	023	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.177	00.000
00.30	020	018	115	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.159	00.000
01.00	020	042	171	00.00	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.115	00.000
01.30	020	059	221	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.01	0.01	002.111	00.000
02.00	020	096	259	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.102	00.000
02.30	020	156	357	00.30	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.088	00.000
03.00	020	183	423	00.38	0.00	0000	0000	0.19	0.00	00.00	00.000	00.00	0.01	0.01	0.01	002.062	00.000
03.30	020	241	484	00.42	0.00	0000	0000	0.19	0.00	00.00	00.000	00.00	0.01	0.02	0.01	002.059	00.000
04.00	020	329	631	00.48	0.01	0000	0000	0.12	0.00	00.00	00.000	00.00	0.02	0.01	0.02	002.032	00.000
04.30	020	361	676	00.49	0.01	0000	0000	0.13	0.00	00.00	00.000	00.00	0.03	0.03	0.03	001.996	00.000
05.00	020	373	678	00.55	0.03	0000	0000	0.15	0.00	00.00	00.000	00.00	0.05	0.04	0.06	001.929	00.000
05.30	021	433	682	00.62	0.06	0000	0000	0.29	0.00	00.00	00.000	00.00	0.10	0.05	0.09	001.861	00.000
06.00	021	465	684	00.63	0.10	0000	0000	0.37	0.00	00.00	00.000	00.00	0.16	0.09	0.17	001.765	00.000
06.30	021	490	702	00.64	0.23	0000	0000	0.59	0.00	00.00	00.000	00.00	0.32	0.19	0.38	001.665	00.000
07.00	021	514	723	00.62	0.43	0000	0000	0.89	0.00	00.00	00.000	00.00	0.57	0.40	0.64	001.494	00.000
07.30	021	492	735	00.53	0.84	0000	0000	1.07	0.00	00.00	00.000	00.00	1.05	0.71	1.23	001.409	00.000
08.00	021	502	746	00.56	1.39	0000	0000	1.24	0.00	00.00	00.000	00.00	1.66	1.26	1.69	001.257	00.000
08.30	021	461	795	00.61	1.76	0000	0000	1.13	0.00	00.00	00.000	00.00	2.45	1.99	2.38	001.103	00.000
09.00	021	407	805	00.66	3.06	0000	0000	1.45	0.00	00.00	00.000	00.00	3.08	2.55	3.07	000.992	00.000
09.30	022	323	802	00.84	3.75	0000	0000	1.65	0.00	00.00	00.000	00.00	3.60	3.43	3.68	000.887	00.000
10.00	022	227	834	00.88	4.54	0000	0000	1.41	0.00	00.00	00.000	00.00	4.26	4.13	4.16	000.791	00.000
10.30	022	193	822	00.73	5.12	0000	0000	1.72	0.00	00.00	00.000	00.00	5.14	5.37	4.73	000.679	00.000
11.00	022	181	824	00.77	5.26	0000	0000	1.59	0.00	00.00	00.000	00.00	5.30	5.51	5.12	000.592	00.000
11.30	022	164	846	00.69	5.27	0000	0000	1.56	0.00	00.00	00.000	00.00	5.57	5.82	5.10	000.509	00.000
12.00	022	174	836	00.89	5.12	0000	0000	1.19	0.00	00.00	00.000	00.00	5.73	5.60	5.37	000.431	00.000
12.30	022	179	851	00.79	5.01	0000	0000	0.39	0.00	00.00	00.000	00.00	5.79	5.83	5.17	000.375	00.000
13.00	022	177	849	00.56	4.44	0000	0000	0.89	0.00	00.00	00.000	00.00	6.17	5.86	5.37	000.311	00.000
13.30	022	166	837	00.77	4.33	0000	0000	0.65	0.00	00.00	00.000	00.00	6.28	5.81	5.61	000.279	00.000
14.00	022	162	853	00.71	4.50	0000	0000	0.55	0.00	00.00	00.000	00.00	6.07	5.76	5.76	000.271	00.000
14.30	022	149	804	00.79	4.39	0000	0000	0.47	0.00	00.00	00.000	00.00	6.02	5.45	5.67	000.256	00.000
15.00	023	134	753	00.73	4.29	0000	0000	0.42	0.00	00.00	00.000	00.00	5.81	5.51	5.61	000.250	00.000
15.30	023	127	711	00.73	4.42	0000	0000	0.41	0.00	00.00	00.000	00.00	5.82	5.34	5.42	000.239	00.000
16.00	023	121	703	00.76	4.31	0000	0000	0.40	0.00	00.00	00.000	00.00	5.67	5.22	5.29	000.212	00.000
16.30	023	115	666	00.74	4.23	0000	0000	0.34	0.00	00.00	00.000	00.00	5.51	4.71	4.97	000.199	00.000
17.00	023	110	639	00.76	4.24	0000	0000	0.32	0.00	00.00	00.000	00.00	5.25	4.91	5.97	000.201	00.000
17.30	023	107	597	00.77	4.32	0000	0000	0.27	0.00	00.00	00.000	00.00	5.38	4.86	4.89	000.177	00.000
18.00	022	103	574	00.74	4.34	0000	0000	0.23	0.00	00.00	00.000	00.00	5.29	4.86	4.79	000.169	00.000
18.30	023	099	571	00.71	4.25	0000	0000	0.27	0.00	00.00	00.000	00.00	5.33	4.84	5.00	000.000	00.000
19.00	023	095	545	00.76	4.36	0000	0000	0.25	0.00	00.00	00.000	00.00	5.13	4.30	4.84	000.000	00.000
19.30	022	092	549	00.67	4.34	0000	0000	0.24	0.00	00.00	00.000	00.00	5.17	4.73	4.83	000.000	00.000
20.00	022	099	535	00.78	4.38	0000	0000	0.23	0.00	00.00	00.000	00.00	5.10	4.81	4.80	000.000	00.000

TABLE 28: Large cribs - 2 m corridor - 20 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	018	059	00.37	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.559	00.000
00.30	014	024	096	00.41	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.301	00.000
01.00	015	045	099	00.33	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.277	00.000
01.30	015	080	122	00.36	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.239	00.000
02.00	015	128	161	00.38	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.224	00.000
02.30	015	182	296	00.39	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.01	0.04	002.275	00.000
03.00	015	225	223	00.40	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.01	0.03	002.266	00.000
03.30	015	249	233	00.40	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.01	0.01	0.04	002.274	00.000
04.00	015	256	275	00.42	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.01	0.01	0.03	002.192	00.000
04.30	015	269	336	00.43	0.00	0000	0000	0.14	0.00	00.00	00.000	00.00	0.01	0.01	0.03	002.196	00.000
05.00	015	323	436	00.46	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.03	0.02	0.06	002.132	00.000
05.30	015	352	669	00.49	0.01	0000	0000	0.33	0.00	00.00	00.000	00.00	0.13	0.05	0.17	002.345	00.000
06.00	015	339	733	00.50	0.21	0000	0000	0.52	0.00	00.00	00.000	00.00	0.35	0.22	0.38	001.923	00.000
06.30	015	362	790	00.52	0.37	0000	0000	0.76	0.00	00.00	00.000	00.00	0.48	0.37	0.65	001.795	00.000
07.00	016	360	676	00.52	0.53	0000	0000	0.95	0.00	00.00	00.000	00.00	0.63	0.57	0.73	001.676	00.000
07.30	016	362	679	00.59	0.74	0000	0000	1.25	0.00	00.00	00.000	00.00	0.76	0.89	1.15	001.579	00.000
08.00	016	425	682	00.55	1.26	0000	0000	1.33	0.00	00.00	00.000	00.00	1.49	1.17	1.65	001.409	00.000
08.30	016	576	684	00.54	1.61	0000	0000	1.32	0.00	00.00	00.000	00.00	1.73	1.59	2.30	001.257	00.000
09.00	016	610	702	00.55	2.18	0000	0000	2.05	0.00	00.00	00.000	00.00	2.79	2.22	2.61	001.103	00.000
09.30	016	569	729	00.57	2.94	0000	0000	2.25	0.00	00.00	00.000	00.00	3.11	2.79	3.22	000.992	00.000
10.00	017	561	733	00.57	3.31	0000	0000	2.41	0.00	00.00	00.000	00.00	4.22	3.44	4.21	000.827	00.000
10.30	016	521	746	00.60	3.79	0000	0000	2.47	0.00	00.00	00.000	00.00	4.57	4.31	5.11	000.791	00.000
11.00	015	483	792	00.59	4.39	0000	0000	2.40	0.00	00.00	00.000	00.00	5.16	4.70	5.47	000.678	00.000
11.30	017	409	862	00.63	4.89	0000	0000	2.37	0.00	00.00	00.000	00.00	5.72	5.41	6.49	000.532	00.000
12.00	015	479	857	00.64	5.44	0000	0000	2.33	0.00	00.00	00.000	00.00	6.19	6.00	6.68	000.590	00.000
12.30	017	458	929	00.68	5.79	0000	0000	2.24	0.00	00.00	00.000	00.00	6.42	6.23	6.77	000.431	00.000
13.00	017	436	891	00.72	6.02	0000	0000	1.97	0.00	00.00	00.000	00.00	6.48	6.75	6.82	000.375	00.000
13.30	017	432	760	00.72	5.77	0000	0000	1.79	0.00	00.00	00.000	00.00	6.22	6.51	6.73	000.311	00.000
14.00	018	370	711	00.66	5.43	0000	0000	1.44	0.00	00.00	00.000	00.00	6.41	6.78	6.42	000.279	00.000
14.30	017	382	644	00.67	5.12	0000	0000	1.21	0.00	00.00	00.000	00.00	6.53	6.61	6.59	000.271	00.000
15.00	017	381	593	00.66	5.05	0000	0000	1.00	0.00	00.00	00.000	00.00	6.23	6.56	6.57	000.256	00.000
15.30	017	353	562	00.67	4.99	0000	0000	0.88	0.00	00.00	00.000	00.00	6.17	6.23	6.54	000.250	00.000
16.00	017	355	540	00.67	4.93	0000	0000	0.80	0.00	00.00	00.000	00.00	5.85	6.34	6.33	000.232	00.000
16.30	018	300	529	00.69	5.17	0000	0000	0.71	0.00	00.00	00.000	00.00	5.67	5.86	6.37	000.212	00.000
17.00	017	295	511	00.68	4.95	0000	0000	0.67	0.00	00.00	00.000	00.00	5.69	5.73	6.51	000.199	00.000
17.30	017	283	501	00.71	4.79	0000	0000	0.61	0.00	00.00	00.000	00.00	5.53	5.53	6.32	000.201	00.000
18.00	017	265	495	00.69	4.92	0000	0000	0.59	0.00	00.00	00.000	00.00	5.61	5.68	6.37	000.177	00.000
18.30	018	265	485	00.74	4.20	0000	0000	0.55	0.00	00.00	00.000	00.00	5.53	5.57	6.22	000.169	00.000
19.00	018	258	469	00.71	4.85	0000	0000	0.52	0.00	00.00	00.000	00.00	5.45	5.67	6.17	000.160	00.000
19.30	018	251	456	00.70	4.32	0000	0000	0.49	0.00	00.00	00.000	00.00	5.47	5.63	6.12	000.151	00.000
20.00	018	242	442	00.70	4.22	0000	0000	0.47	0.00	00.00	00.000	00.00	5.43	5.53	6.12	000.129	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	015	029	031	00.30	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.489	00.000
00.30	015	037	044	00.32	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.494	00.000
01.00	015	043	057	00.27	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.486	00.000
01.30	015	052	078	00.31	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.489	00.000
02.00	015	079	122	00.33	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.03	002.471	00.000
02.30	015	102	185	00.35	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.471	00.000
03.00	015	126	223	00.36	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.460	00.000
03.30	015	140	269	00.38	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.01	0.01	0.02	002.445	00.000
04.00	015	159	294	00.41	0.00	0000	0000	0.12	0.00	00.00	00.000	00.00	0.01	0.01	0.03	002.411	00.000
04.30	015	189	337	00.44	0.00	0000	0000	0.14	0.00	00.00	00.000	00.00	0.02	0.02	0.06	002.409	00.000
05.00	015	229	452	00.49	0.00	0000	0000	0.19	0.00	00.00	00.000	00.00	0.03	0.02	0.08	002.330	00.000
05.30	015	291	629	00.55	0.02	0000	0000	0.31	0.00	00.00	00.000	00.00	0.12	0.05	0.22	002.275	00.000
06.00	016	331	675	00.53	0.18	0000	0000	0.45	0.00	00.00	00.000	00.00	0.33	0.29	0.29	002.235	00.000
06.30	016	401	653	00.53	0.26	0000	0000	0.77	0.00	00.00	00.000	00.00	0.45	0.39	0.40	002.092	00.000
07.00	016	394	640	00.59	0.38	0000	0000	0.73	0.00	00.00	00.000	00.00	0.60	0.48	0.73	001.975	00.000
07.30	016	421	644	00.61	0.75	0000	0000	1.13	0.00	00.00	00.000	00.00	1.02	0.75	1.22	001.937	00.000
08.00	016	467	657	00.63	1.19	0000	0000	1.48	0.00	00.00	00.000	00.00	1.83	1.23	1.74	001.799	00.000
08.30	016	501	664	00.59	1.73	0000	0000	1.86	0.00	00.00	00.000	00.00	2.31	1.71	2.13	001.573	00.000
09.00	016	525	681	00.60	2.40	0000	0000	2.23	0.00	00.00	00.000	00.00	2.89	2.30	3.08	001.440	00.000
09.30	016	540	693	00.59	2.99	0000	0000	2.36	0.00	00.00	00.000	00.00	3.67	2.97	3.81	001.315	00.000
10.00	016	510	736	00.61	3.62	0000	0000	2.24	0.00	00.00	00.000	00.00	4.17	3.62	4.09	001.213	00.000
10.30	016	477	748	00.60	3.59	0000	0000	2.30	0.00	00.00	00.000	00.00	4.55	4.44	4.63	001.114	00.000
11.00	017	447	843	00.63	4.12	0000	0000	2.07	0.00	00.00	00.000	00.00	5.13	4.72	5.32	000.991	00.000
11.30	017	432	845	00.66	4.90	0000	0000	2.19	0.00	00.00	00.000	00.00	5.74	5.29	5.72	000.911	00.000
12.00	017	428	833	00.68	4.77	0000	0000	2.02	0.00	00.00	00.000	00.00	6.23	5.77	6.32	000.830	00.000
12.30	017	434	901	00.73	4.41	0000	0000	1.85	0.00	00.00	00.000	00.00	6.52	6.13	6.37	000.754	00.000
13.00	017	456	761	00.72	4.53	0000	0000	1.56	0.00	00.00	00.000	00.00	5.97	6.20	5.92	000.704	00.000
13.30	017	461	711	00.74	4.41	0000	0000	1.33	0.00	00.00	00.000	00.00	5.56	6.27	5.39	000.665	00.000
14.00	017	439	649	00.70	4.59	0000	0000	1.11	0.00	00.00	00.000	00.00	5.46	6.04	5.84	000.621	00.000
14.30	017	425	611	00.71	4.26	0000	0000	0.96	0.00	00.00	00.000	00.00	5.22	6.05	5.28	000.571	00.000
15.00	017	400	579	00.69	4.22	0000	0000	0.86	0.00	00.00	00.000	00.00	5.23	5.70	5.73	000.536	00.000
15.30	017	393	555	00.75	4.21	0000	0000	0.75	0.00	00.00	00.000	00.00	5.23	5.60	5.95	000.524	00.000
16.00	017	384	537	00.77	4.05	0000	0000	0.71	0.00	00.00	00.000	00.00	5.19	5.42	5.87	000.493	00.000
16.30	017	367	516	00.73	4.07	0000	0000	0.63	0.00	00.00	00.000	00.00	5.26	5.34	5.79	000.457	00.000
17.00	017	361	502	00.75	3.71	0000	0000	0.59	0.00	00.00	00.000	00.00	5.13	5.29	5.67	000.444	00.000
17.30	017	355	491	00.76	3.76	0000	0000	0.57	0.00	00.00	00.000	00.00	5.19	5.21	5.63	000.410	00.000
18.00	017	347	478	00.74	4.30	0000	0000	0.52	0.00	00.00	00.000	00.00	5.14	5.13	5.52	000.391	00.000
18.30	017	339	469	00.74	4.07	0000	0000	0.51	0.00	00.00	00.000	00.00	4.94	5.16	5.53	000.371	00.000
19.00	017	330	457	00.78	3.95	0000	0000	0.47	0.00	00.00	00.000	00.00	5.09	5.08	5.53	000.360	00.000
19.30	017	324	448	00.78	4.10	0000	0000	0.46	0.00	00.00	00.000	00.00	5.06	5.10	5.43	000.342	00.000
20.00	017	318	437	00.78	4.08	0000	0000	0.44	0.00	00.00	00.000	00.00	4.86	5.03	5.36	000.321	00.000

TABLE 29: Large cribs - 2 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	019	047	065	00.15	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.268	00.000
00.30	013	060	134	00.31	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.439	00.000
01.00	016	091	191	00.31	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.409	00.000
01.30	016	119	273	00.29	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.02	002.356	00.000
02.00	016	143	379	00.37	0.01	0000	0000	0.11	0.00	00.00	00.000	00.00	0.02	0.01	0.04	002.369	00.000
02.30	016	179	455	00.36	0.01	0000	0000	0.12	0.00	00.00	00.000	00.00	0.03	0.02	0.05	002.363	00.000
03.00	016	216	635	00.37	0.02	0000	0000	0.14	0.00	00.00	00.000	00.00	0.04	0.03	0.07	002.231	00.000
03.30	016	272	816	00.37	0.04	0000	0000	0.21	0.00	00.00	00.000	00.00	0.07	0.04	0.11	002.228	00.000
04.00	017	386	737	00.37	0.16	0000	0000	0.34	0.00	00.00	00.000	00.00	0.27	0.13	0.44	002.123	00.000
04.30	016	445	711	00.41	0.35	0000	0000	0.49	0.00	00.00	00.000	00.00	0.41	0.39	0.46	002.057	00.000
05.00	016	428	709	00.43	0.34	0000	0000	0.69	0.00	00.00	00.000	00.00	0.38	0.31	0.47	001.942	00.000
05.30	016	495	699	00.42	0.38	0000	0000	0.86	0.00	00.00	00.000	00.00	0.49	0.41	0.60	001.843	00.000
06.00	020	517	707	00.46	0.49	0000	0000	1.07	0.00	00.00	00.000	00.00	0.69	0.56	0.74	001.728	00.000
06.30	019	536	726	00.47	0.67	0000	0000	1.33	0.00	00.00	00.000	00.00	1.02	0.77	0.94	001.530	00.000
07.00	018	595	735	00.47	0.97	0000	0000	1.66	0.00	00.00	00.000	00.00	1.25	1.01	1.31	001.399	00.000
07.30	017	628	746	00.47	1.15	0000	0000	2.20	0.00	00.00	00.000	00.00	1.54	1.31	1.56	001.297	00.000
08.00	017	666	765	00.47	1.46	0000	0000	2.38	0.00	00.00	00.000	00.00	1.9	1.58	1.88	001.166	00.000
08.30	018	673	777	00.49	1.71	0000	0000	2.81	0.00	00.00	00.000	00.00	2.23	2.06	2.48	001.056	00.000
09.00	018	683	795	00.50	2.11	0000	0000	2.85	0.00	00.00	00.000	00.00	2.42	2.40	2.64	000.941	00.000
09.30	019	710	825	00.52	2.48	0000	0000	2.87	0.00	00.00	00.000	00.00	2.73	2.66	2.91	000.846	00.000
10.00	018	661	854	00.52	2.41	0000	0000	2.70	0.00	00.00	00.000	00.00	3.07	2.91	3.69	000.721	00.000
10.30	019	595	892	00.51	2.62	0000	0000	2.45	0.00	00.00	00.000	00.00	3.29	3.36	3.64	000.615	00.000
11.00	019	565	910	00.53	2.75	0000	0000	2.25	0.00	00.00	00.000	00.00	3.74	3.66	4.25	000.540	00.000
11.30	020	558	923	00.53	3.15	0000	0000	2.30	0.00	00.00	00.000	00.00	4.19	4.10	4.65	000.504	00.000
12.00	020	546	953	00.52	3.77	0000	0000	2.28	0.00	00.00	00.000	00.00	4.40	4.12	4.79	000.415	00.000
12.30	020	537	956	00.54	3.55	0000	0000	2.22	0.00	00.00	00.000	00.00	4.77	4.88	5.93	000.395	00.000
13.00	020	525	926	00.53	3.67	0000	0000	1.94	0.00	00.00	00.000	00.00	4.63	5.01	5.26	000.323	00.000
13.30	021	511	009	00.55	3.45	0000	0000	1.69	0.00	00.00	00.000	00.00	4.57	5.03	5.11	000.267	00.000
14.00	021	495	948	00.55	3.43	0000	0000	1.46	0.00	00.00	00.000	00.00	4.51	4.78	4.73	000.244	00.000
14.30	022	475	917	00.55	3.54	0000	0000	1.28	0.00	00.00	00.000	00.00	4.38	4.78	4.66	000.217	00.000
15.00	021	461	898	00.57	3.44	0000	0000	1.07	0.00	00.00	00.000	00.00	4.33	4.69	4.57	000.211	00.000
15.30	021	450	868	00.56	3.42	0000	0000	0.99	0.00	00.00	00.000	00.00	4.02	4.38	4.62	000.174	00.000
16.00	020	437	842	00.56	3.50	0000	0000	0.87	0.00	00.00	00.000	00.00	4.13	4.41	4.56	000.159	00.000
16.30	023	427	815	00.56	3.41	0000	0000	0.82	0.00	00.00	00.000	00.00	4.12	4.18	4.59	000.151	00.000
17.00	023	418	798	00.55	3.45	0000	0000	0.76	0.00	00.00	00.000	00.00	3.93	4.21	4.59	000.128	00.000
17.30	023	414	784	00.53	3.22	0000	0000	0.71	0.00	00.00	00.000	00.00	3.86	4.16	4.61	000.119	00.000
18.00	023	404	767	00.60	3.23	0000	0000	0.67	0.00	00.00	00.000	00.00	3.91	4.06	4.54	000.099	00.000
18.30	023	388	728	00.59	3.32	0000	0000	0.62	0.00	00.00	00.000	00.00	3.85	4.07	4.45	000.092	00.000
19.00	023	378	711	00.53	3.27	0000	0000	0.60	0.00	00.00	00.000	00.00	3.65	4.39	4.44	000.066	00.000
19.30	023	371	695	00.61	3.27	0000	0000	0.58	0.00	00.00	00.000	00.00	3.67	4.02	4.44	000.053	00.000
20.00	023	361	681	00.61	3.24	0000	0000	0.52	0.00	00.00	00.000	00.00	3.75	3.99	4.40	000.046	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	018	029	031	00.07	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.334	00.000
00.30	018	031	073	00.17	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.334	00.000
01.00	018	037	106	00.13	0.00	0000	0000	0.08	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.309	00.000
01.30	018	046	145	00.17	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.00	002.316	00.000
02.00	018	079	265	00.21	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.288	00.000
02.30	018	120	360	00.27	0.01	0000	0000	0.10	0.00	00.00	00.000	00.00	0.02	0.00	0.02	002.254	00.000
03.00	018	167	539	00.34	0.02	0000	0000	0.13	0.00	00.00	00.000	00.00	0.03	0.01	0.06	002.274	00.000
03.30	018	230	745	00.38	0.04	0000	0000	0.16	0.00	00.00	00.000	00.00	0.08	0.03	0.14	002.165	00.000
04.00	018	279	743	00.39	0.12	0000	0000	0.20	0.00	00.00	00.000	00.00	0.30	0.10	0.34	002.097	00.000
04.30	015	359	711	00.38	0.31	0000	0000	0.29	0.00	00.00	00.000	00.00	0.43	0.26	0.46	002.022	00.000
05.00	018	404	674	00.40	0.23	0000	0000	0.55	0.00	00.00	00.000	00.00	0.33	0.31	0.40	001.976	00.000
05.30	018	415	675	00.41	0.29	0000	0000	0.63	0.00	00.00	00.000	00.00	0.37	0.33	0.41	001.814	00.000
06.00	018	421	669	00.42	0.35	0000	0000	0.80	0.00	00.00	00.000	00.00	0.39	0.37	0.49	001.691	00.000
06.30	018	417	673	00.45	0.45	0000	0000	0.72	0.00	00.00	00.000	00.00	0.59	0.47	0.64	001.594	00.000
07.00	018	423	692	00.50	0.60	0000	0000	1.13	0.00	00.00	00.000	00.00	0.81	0.56	0.73	001.465	00.000
07.30	018	438	706	00.48	0.50	0000	0000	1.39	0.00	00.00	00.000	00.00	1.09	0.81	1.18	001.354	00.000
08.00	018	471	727	00.49	1.04	0000	0000	1.58	0.00	00.00	00.000	00.00	1.26	1.14	1.42	001.279	00.000
08.30	019	496	744	00.48	1.07	0000	0000	1.50	0.00	00.00	00.000	00.00	1.49	1.36	1.78	001.110	00.000
09.00	019	493	757	00.52	1.40	0000	0000	1.84	0.00	00.00	00.000	00.00	1.56	1.64	2.03	001.041	00.000
09.30	019	473	786	00.54	1.52	0000	0000	1.76	0.00	00.00	00.000	00.00	2.08	1.94	2.36	000.934	00.000
10.00	019	457	818	00.51	1.74	0000	0000	1.87	0.00	00.00	00.000	00.00	2.31	2.14	2.48	000.849	00.000
10.30	019	459	845	00.53	1.89	0000	0000	1.73	0.00	00.00	00.000	00.00	2.36	2.36	2.74	000.736	00.000
11.00	019	435	830	00.50	2.06	0000	0000	1.70	0.00	00.00	00.000	00.00	2.69	2.67	2.91	000.679	00.000
11.30	019	432	867	00.52	2.14	0000	0000	1.77	0.00	00.00	00.000	00.00	2.97	2.76	3.22	000.603	00.000
12.00	019	431	910	00.51	2.33	0000	0000	1.77	0.00	00.00	00.000	00.00	3.14	2.89	3.41	000.521	00.000
12.30	019	425	941	00.53	2.39	0000	0000	1.73	0.00	00.00	00.000	00.00	3.19	3.28	3.45	000.499	00.000
13.00	019	422	962	00.57	2.47	0000	0000	1.62	0.00	00.00	00.000	00.00	3.50	3.54	3.73	000.431	00.000
13.30	019	417	742	00.58	2.77	0000	0000	1.65	0.00	00.00	00.000	00.00	3.51	3.70	3.76	000.379	00.000
14.00	020	402	637	00.60	2.57	0000	0000	1.42	0.00	00.00	00.000	00.00	3.47	3.73	3.75	000.320	00.000
14.30	020	393	538	00.61	2.52	0000	0000	1.23	0.00	00.00	00.000	00.00	3.49	3.29	3.69	000.266	00.000
15.00	020	376	171	00.63	2.44	0000	0000	1.09	0.00	00.00	00.000	00.00	3.45	3.76	3.67	000.287	00.000
15.30	019	358	105	00.62	2.58	0000	0000	1.09	0.00	00.00	00.000	00.00	3.34	3.66	3.57	000.226	00.000
16.00	019	342	088	00.61	2.49	0000	0000	0.85	0.00	00.00	00.000	00.00	3.19	3.69	3.50	000.230	00.000
16.30	020	334	085	00.57	2.52	0000	0000	0.67	0.00	00.00	00.000	00.00	3.22	3.60	3.50	000.201	00.000
17.00	020	323	089	00.61	2.47	0000	0000	0.73	0.00	00.00	00.000	00.00	3.04	3.64	3.46	000.190	00.000
17.30	020	318	093	00.60	2.41	0000	0000	0.69	0.00	00.00	00.000	00.00	3.08	3.53	3.48	000.154	00.000
18.00	020	304	095	00.61	2.51	0000	0000	0.63	0.00	00.00	00.000	00.00	3.13	3.37	3.40	000.111	00.000
18.30	020	303	098	00.62	2.38	0000	0000	0.61	0.00	00.00	00.000	00.00	3.20	3.39	3.51	000.086	00.000
19.00	020	290	099	00.61	2.46	0000	0000	0.59	0.00	00.00	00.000	00.00	3.34	3.38	3.50	000.075	00.000
19.30	020	282	102	00.60	2.33	0000	0000	0.55	0.00	00.00	00.000	00.00	3.02	3.35	3.36	000.050	00.000
20.00	020	278	104	00.58	2.48	0000	0000	0.53	0.00	00.00	00.000	00.00	2.94	3.29	3.44	000.04	00.000

TABLE 29: Large cribs - 2 m corridor - 10 cm opening (continued).

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg.	WT.LOSS Kg/MIN
00.00	021	043	074	00.00	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.00	002.501	00.000
00.30	029	061	065	00.16	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.00	0.00	0.01	002.420	00.000
01.00	021	080	101	00.25	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.03	002.408	00.000
01.30	021	103	129	00.27	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.01	002.390	00.000
02.00	021	135	149	00.29	0.00	0000	0000	0.09	0.00	00.00	00.000	00.00	0.00	0.00	0.02	002.371	00.000
02.30	021	165	175	00.32	0.00	0000	0000	0.10	0.00	00.00	00.000	00.00	0.01	0.00	0.04	002.374	00.000
03.00	021	192	204	00.32	0.00	0000	0000	0.11	0.00	00.00	00.000	00.00	0.03	0.01	0.05	002.349	00.000
03.30	021	224	254	00.33	0.00	0000	0000	0.13	0.00	00.00	00.000	00.00	0.03	0.02	0.07	002.294	00.000
04.00	022	286	338	00.34	0.00	0000	0000	0.18	0.00	00.00	00.000	00.00	0.07	0.03	0.10	002.253	00.000
04.30	022	374	384	00.37	0.13	0000	0000	0.24	0.00	00.00	00.000	00.00	0.27	0.12	0.41	002.137	00.000
05.00	022	459	419	00.33	0.33	0000	0000	0.36	0.00	00.00	00.000	00.00	0.44	0.33	0.59	002.031	00.000
05.30	022	497	442	00.37	0.29	0000	0000	0.50	0.00	00.00	00.000	00.00	0.33	0.33	0.45	001.899	00.000
06.00	023	495	476	00.45	0.36	0000	0000	0.60	0.00	00.00	00.000	00.00	0.49	0.44	0.55	001.787	00.000
06.30	022	509	521	00.45	0.57	0000	0000	0.74	0.00	00.00	00.000	00.00	0.66	0.58	0.83	001.657	00.000
07.00	023	524	559	00.46	0.73	0000	0000	0.88	0.00	00.00	00.000	00.00	0.97	0.83	1.13	001.533	00.000
07.30	023	585	583	00.43	1.05	0000	0000	1.26	0.00	00.00	00.000	00.00	1.24	1.23	1.53	001.403	00.000
08.00	023	629	611	00.46	1.25	0000	0000	1.80	0.00	00.00	00.000	00.00	1.76	1.45	1.73	001.292	00.000
08.30	024	626	637	00.45	1.79	0000	0000	2.03	0.00	00.00	00.000	00.00	2.35	2.00	2.21	001.165	00.000
09.00	024	631	669	00.44	2.29	0000	0000	2.23	0.00	00.00	00.000	00.00	2.81	2.40	2.62	001.032	00.000
09.30	025	613	704	00.43	2.57	0000	0000	2.39	0.00	00.00	00.000	00.00	3.46	2.91	3.17	000.974	00.000
10.00	025	587	732	00.46	2.86	0000	0000	2.44	0.00	00.00	00.000	00.00	3.69	3.53	3.63	000.853	00.000
10.30	025	537	755	00.45	3.50	0000	0000	2.38	0.00	00.00	00.000	00.00	4.17	3.77	4.22	000.751	00.000
11.00	024	511	779	00.44	3.44	0000	0000	2.35	0.00	00.00	00.000	00.00	4.33	4.43	4.63	000.742	00.000
11.30	024	506	803	00.50	3.79	0000	0000	2.30	0.00	00.00	00.000	00.00	4.76	4.73	5.41	000.531	00.000
12.00	025	496	829	00.46	4.12	0000	0000	2.22	0.00	00.00	00.000	00.00	5.47	5.14	4.85	000.56	00.000
12.30	025	492	849	00.46	4.01	0000	0000	1.76	0.00	00.00	00.000	00.00	5.21	5.50	5.43	000.527	00.000
13.00	025	479	873	00.49	4.47	0000	0000	1.69	0.00	00.00	00.000	00.00	5.63	5.55	5.62	000.458	00.000
13.30	025	469	886	00.51	4.43	0000	0000	1.45	0.00	00.00	00.000	00.00	5.51	6.15	5.67	000.411	00.000
14.00	025	452	889	00.59	4.66	0000	0000	1.14	0.00	00.00	00.000	00.00	5.43	6.17	5.49	000.336	00.000
14.30	024	441	883	00.56	4.60	0000	0000	0.99	0.00	00.00	00.000	00.00	5.33	6.16	5.59	000.349	00.000
15.00	024	426	893	00.54	4.59	0000	0000	0.86	0.00	00.00	00.000	00.00	4.39	6.15	5.29	000.337	00.000
15.30	025	412	899	00.54	4.45	0000	0000	0.74	0.00	00.00	00.000	00.00	4.75	5.84	5.37	000.313	00.000
16.00	024	398	863	00.54	4.14	0000	0000	0.67	0.00	00.00	00.000	00.00	4.71	5.35	5.53	000.322	00.000
16.30	024	381	835	00.53	4.29	0000	0000	0.59	0.00	00.00	00.000	00.00	4.64	5.73	5.33	000.330	00.000
17.00	024	365	813	00.56	4.12	0000	0000	0.55	0.00	00.00	00.000	00.00	4.82	5.51	5.45	000.298	00.000
17.30	024	352	794	00.57	4.07	0000	0000	0.50	0.00	00.00	00.000	00.00	4.58	5.42	5.34	000.291	00.000
18.00	024	337	776	00.59	4.24	0000	0000	0.45	0.00	00.00	00.000	00.00	4.52	5.27	5.16	000.281	00.000
18.30	024	328	761	00.59	4.04	0000	0000	0.43	0.00	00.00	00.000	00.00	4.64	5.12	5.24	000.260	00.000
19.00	024	319	746	00.61	4.11	0000	0000	0.37	0.00	00.00	00.000	00.00	4.43	5.05	5.30	000.254	00.000
19.30	024	312	732	00.57	4.03	0000	0000	0.38	0.00	00.00	00.000	00.00	4.71	5.03	5.24	000.235	00.000
20.00	024	303	719	00.60	4.05	0000	0000	0.33	0.00	00.00	00.000	00.00	4.56	4.95	5.14	000.229	00.000

TABLE 30: PMMA - free burning.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
01.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
01.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
02.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
02.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.02	000.000	00.000
03.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.02	0.00	0.04	000.000	00.000
03.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.06	0.03	0.09	000.000	00.000
04.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.07	0.05	0.11	000.000	00.000
04.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.09	0.12	0.15	000.000	00.000
05.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.11	0.16	0.19	000.000	00.000
05.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.13	0.21	0.26	000.000	00.000
06.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.23	0.32	000.000	00.000
06.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.25	0.37	0.37	000.000	00.000
07.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.36	0.39	0.47	000.000	00.000
07.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.35	0.45	0.48	000.000	00.000
08.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.37	0.59	0.53	000.000	00.000
08.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.43	0.51	0.47	000.000	00.000
09.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.39	0.52	0.53	000.000	00.000
09.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.55	0.52	000.000	00.000
10.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.53	0.49	000.000	00.000
10.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.42	0.56	0.46	000.000	00.000
11.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.52	0.46	000.000	00.000
11.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.52	0.45	000.000	00.000
12.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.52	0.46	000.000	00.000
12.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.51	0.45	000.000	00.000
13.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.53	0.43	000.000	00.000
13.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.46	0.56	0.42	000.000	00.000
14.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.43	0.54	0.41	000.000	00.000
14.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.42	0.56	0.41	000.000	00.000
15.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.49	0.54	0.38	000.000	00.000
15.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.48	0.52	0.35	000.000	00.000
16.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.42	0.54	0.34	000.000	00.000
16.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.50	0.32	000.000	00.000
17.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.51	0.33	000.000	00.000
17.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.50	0.33	000.000	00.000
18.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.45	0.33	000.000	00.000
18.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.45	0.46	0.34	000.000	00.000
19.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.44	0.46	0.33	000.000	00.000
19.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.43	0.46	0.34	000.000	00.000
20.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.42	0.45	0.36	000.000	00.000

TABLE 31: PMMA - box - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	019	000	047	00.00	0.00	0000	0000	0.13	0.00	00.00	00.032	20.94	0.00	0.00	0.00	000.000	00.000
00.30	019	000	131	00.00	0.00	0000	0000	0.24	0.00	00.00	00.04	20.95	0.00	0.00	0.00	000.000	00.000
01.00	019	000	115	00.00	0.00	0000	0000	0.25	0.00	00.03	00.345	21.00	0.00	0.00	0.00	000.000	00.000
01.30	019	000	187	00.00	0.00	0000	0000	0.42	0.00	00.25	00.441	21.02	0.00	0.00	0.00	000.000	00.000
02.00	019	000	255	00.00	0.00	0000	0000	0.60	0.00	00.74	00.437	21.02	0.00	0.00	0.00	000.000	00.000
02.30	019	000	327	00.00	0.00	0000	0000	0.76	0.00	00.87	00.462	20.74	0.00	0.00	0.01	000.000	00.000
03.00	019	000	409	00.00	0.00	0000	0000	1.42	0.00	01.47	00.663	20.30	0.00	0.00	0.01	000.000	00.000
03.30	019	000	514	00.00	0.00	0000	0000	2.23	0.00	01.25	00.491	19.77	0.01	0.00	0.03	000.000	00.000
04.00	019	000	711	00.00	0.00	0000	0000	2.63	0.00	02.49	00.472	19.18	0.09	0.94	0.11	000.000	00.000
04.30	019	000	784	00.00	0.00	0000	0000	0.30	0.00	03.57	00.375	18.30	0.37	0.67	0.79	000.000	00.000
05.00	019	001	742	00.00	0.00	0000	0000	3.56	0.00	05.25	00.498	16.79	1.35	0.96	1.19	000.000	00.000
05.30	019	000	519	00.00	0.00	0000	0000										
06.00	019	000	361	00.00	0.00	0000	0000	1.47	0.00	06.25	00.165	14.37	1.71	1.66	1.54	000.000	00.000
06.30	019	000	295	00.00	0.00	0000	0000	0.55	0.00	09.21	00.434	12.19	[illegible]	1.63	1.26	000.000	00.000
07.00	019	000	252	00.00	0.00	0000	0000	0.47	0.00	11.29	00.152	11.13	1.31	1.51	1.46	000.000	00.000
07.30	019	000	237	00.00	0.00	0000	0000	0.35	0.00	12.73	01.239	11.34	1.44	1.30	1.43	000.000	00.000
08.00	019	000	214	00.00	0.00	0000	0000	0.33	0.00	12.57	01.271	13.44	1.41	1.49	1.37	000.000	00.000
08.30	019	000	196	00.00	0.00	0000	0000	0.27	0.00	12.17	00.546	16.33	1.37	1.75	1.33	000.000	00.000
09.00	019	000	180	00.00	0.00	0000	0000	0.27	0.00	12.00	00.111	18.32	1.37	1.71	1.31	000.000	00.000
09.30	019	000	159	00.00	0.00	0000	0000	0.24	0.00	11.20	00.121	18.79	1.33	1.71	1.33	000.000	00.000
10.00	019	000	153	00.00	0.00	0000	0000	0.22	0.00	11.59	00.152	19.21	1.23	1.66	1.21	000.000	00.000
10.30	019	000	148	00.00	0.00	0000	0000	0.23	0.00	11.54	00.174	19.30	1.23	1.54	1.24	000.000	00.000
11.00	019	000	140	00.00	0.00	0000	0000	0.19	0.00	11.13	00.121	19.55	1.25	1.54	1.24	000.000	00.000
11.30	019	000	132	00.00	0.00	0000	0000	0.19	0.00	09.25	00.179	19.77	1.22	1.51	1.29	000.000	00.000
12.00	019	000	125	00.00	0.00	0000	0000	0.23	0.00	07.25	00.169	19.95	1.18	1.42	1.21	000.000	00.000
12.30	010	000	120	00.00	0.00	0000	0000	0.19	0.00	05.71	00.155	19.99	1.14	1.41	1.15	000.000	00.000
13.00	019	000	114	00.00	0.00	0000	0000	0.19	0.00	04.25	00.145	20.05	1.29	1.33	1.13	000.000	00.000
13.30	019	000	110	00.00	0.00	0000	0000	0.18	0.00	04.49	00.146	20.19	1.11	1.32	1.12	000.000	00.000
14.00	010	000	105	00.00	0.00	0000	0000	0.13	0.00	04.23	00.144	20.25	1.11	1.33	1.14	000.000	00.000
14.30	011	000	100	00.00	0.00	0000	0000	0.17	0.00	04.13	00.119	20.33	1.12	1.31	1.15	000.000	00.000
15.00	010	000	094	00.00	0.00	0000	0000	0.17	0.00	04.17	00.103	20.42	1.09	1.33	1.16	000.000	00.000
15.30	010	000	092	00.00	0.00	0000	0000	0.16	0.00	03.74	00.102	20.44	1.15	1.33	1.15	000.000	00.000
16.00	011	000	087	00.00	0.00	0000	0000	0.15	0.00	02.57	00.090	20.48	1.17	1.27	1.13	000.000	00.000
16.30	011	000	086	00.00	0.00	0000	0000	0.15	0.00	01.58	00.077	20.53	1.17	1.23	1.18	000.000	00.000
17.00	011	000	083	00.00	0.00	0000	0000	0.14	0.00	01.30	00.098	20.62	1.18	1.23	1.14	000.000	00.000
17.30	010	000	080	00.00	0.00	0000	0000	0.14	0.00	01.16	00.097	20.69	1.23	1.24	1.16	000.000	00.000
18.00	011	000	073	00.00	0.00	0000	0000	0.14	0.00	01.00	00.090	20.75	1.29	1.26	1.12	000.000	00.000
18.30	011	000	075	00.00	0.00	0000	0000	0.13	0.00	00.72	00.096	20.77	1.18	1.25	1.12	000.000	00.000
19.00	011	000	073	00.00	0.00	0000	0000	0.13	0.00	00.32	00.095	20.77	1.22	1.30	1.10	000.000	00.000
19.30	011	000	070	00.00	0.00	0000	0000	0.13	0.00	00.73	00.093	20.84	1.22	1.25	1.13	000.000	00.000
20.00	011	000	067	00.00	0.00	0000	0000	0.13	0.00	00.68	00.081	20.87	1.20	1.25	1.10	000.000	00.000
								0.12	0.00	00.54	00.079	20.71	1.2	1.25	1.12	000.000	00.000

TABLE 32: PMMA - 1 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	062	112	00.27	00.0	0000	0000	0.09	0.00	00.00	00.070	18.75	0.00	0.00	0.00	000.000	00.000
00.30	013	103	152	00.57	00.0	0000	0000	0.09	0.00	00.90	00.078	18.53	0.00	0.00	0.00	000.000	00.000
01.00	013	130	192	00.59	00.3	0000	0000	0.10	0.00	01.50	00.082	18.92	0.00	0.00	0.00	000.000	00.000
01.30	013	157	237	00.64	00.6	0001	0000	0.12	0.00	02.11	00.084	17.35	0.00	0.00	0.00	000.000	00.000
02.00	013	176	264	00.81	01.3	0003	0000	0.14	0.00	02.56	00.088	17.06	0.00	0.00	0.00	000.000	00.000
02.30	013	205	299	00.99	01.9	0005	0002	0.15	0.00	02.88	00.091	16.46	0.00	0.00	0.00	000.000	00.000
03.00	013	248	386	00.94	06.0	0016	0008	0.23	0.00	02.93	00.093	16.21	0.00	0.00	0.00	000.000	00.000
03.30	013	305	514	01.00	09.9	0030	0018	0.49	0.00	03.39	00.097	15.93	0.00	0.00	0.00	000.000	00.000
04.00	013	404	604	01.11	09.5	0038	0033	0.73	0.00	05.59	00.114	15.13	0.00	0.00	0.00	000.000	00.000
04.30	013	367	479	01.01	06.3	0022	0047	0.54	0.00	07.29	00.142	13.46	0.00	0.00	0.00	000.000	00.000
05.00	013	254	312	00.89	02.7	0007	0054	0.30	0.00	05.86	00.127	12.42	0.00	0.00	0.00	000.000	00.000
05.30	013	185	221	00.87	01.2	0003	0054	0.19	0.00	02.52	00.107	13.99	0.00	0.00	0.00	000.000	00.000
06.00	013	144	170	00.70	01.0	0002	0054	0.15	0.00	01.26	00.097	16.52	0.00	0.00	0.00	000.000	00.000
06.30	013	115	160	00.62	00.7	0001	0054	0.13	0.00	00.65	00.093	17.75	0.00	0.00	0.00	000.000	00.000
07.00	013	099	154	00.59	00.6	0001	0054	0.13	0.00	00.29	00.090	18.06	0.00	0.00	0.00	000.000	00.000
07.30	013	069	126	00.56	00.6	0001	0054	0.12	0.00	00.12	00.089	18.60	0.00	0.00	0.00	000.000	00.000
08.00	013	081	115	00.52	00.5	0000	0054	0.12	0.00	00.00	00.089	18.56	0.00	0.00	0.00	000.000	00.000

TABLE 33: PMMA - 1 m corridor - 10 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS kg/MIN
00.00	011	000	346	00.37	0.00	0000	0000	0.10	0.00	00.00	00.000	21.14	0.00	0.00	0.00	000.000	00.000
00.30	010	052	103	00.50	0.00	0000	0000	0.09	0.00	00.00	00.000	21.10	0.00	0.00	0.00	000.000	00.000
01.00	010	047	100	00.33	0.00	0000	0000	0.09	0.00	00.00	00.000	21.11	0.00	0.00	0.00	000.000	00.000
01.30	010	063	143	00.47	0.00	0000	0000	0.19	0.00	00.00	00.000	21.11	0.00	0.00	0.00	000.000	00.000
02.00	010	110	263	00.52	0.00	0000	0000	0.10	0.00	00.00	00.000	21.10	0.00	0.00	0.00	000.000	00.000
02.30	010	173	415	00.62	0.00	0000	0000	0.13	0.00	00.00	00.000	21.11	0.00	0.00	0.01	000.000	00.000
03.00	010	233	609	00.75	0.00	0000	0000	0.17	0.00	00.00	00.075	21.02	0.02	0.01	0.01	000.000	00.000
03.30	011	277	747	00.63	0.00	0000	0000	0.35	0.00	00.00	00.074	21.06	0.15	0.05	0.09	000.000	00.000
04.00	011	494	734	00.54	0.00	0000	0000	1.73	0.00	00.00	00.076	21.07	0.37	0.57	0.60	000.000	00.000
04.31	011	336	762	00.39	0.00	0000	0000	0.25	0.00	00.00	00.075	21.04	1.05	0.87	0.93	000.000	00.000
05.00	011	233	633	00.54	0.00	0000	0000	0.24	0.00	00.12	00.075	15.63	1.30	1.34	1.42	000.000	00.000
05.30	011	175	411	00.43	0.00	0000	0000	0.29	0.00	00.37	00.076	13.63	1.39	1.33	1.03	000.000	00.000
06.00	011	145	349	00.50	0.00	0000	0000	0.23	0.00	00.75	00.144	11.61	1.13	1.22	1.13	000.000	00.000
06.30	011	127	300	00.48	0.00	0000	0000	0.20	0.00	01.40	00.313	09.63	1.09	1.22	1.03	000.000	00.000
07.00	011	112	264	00.49	0.00	0000	0000	0.18	0.00	11.74	00.765	10.40	0.94	1.21	1.01	000.000	00.000
07.30	011	103	239	00.43	0.00	0000	0000	0.17	0.00	10.98	01.472	10.91	0.91	1.27	1.03	000.000	00.000
08.00	011	[illegible]	221	00.47	0.00	0000	0000	0.15	0.00	10.05	00.881	11.83	0.94	1.29	1.11	000.000	00.000
08.30	011	093	204	00.44	0.00	0000	0000	0.15	0.00	09.23	00.546	13.34	0.85	1.31	1.11	000.000	00.000
09.00	011	087	190	00.47	0.00	0000	0000	0.14	0.00	01.09	00.433	21.14	0.86	1.23	1.10	000.000	00.000
09.30	011	083	181	00.46	0.00	0000	0000	0.14	0.00	00.97	00.279	21.12	0.83	1.21	1.06	000.000	00.000
10.00	011	077	172	00.44	0.00	0000	0000	0.13	0.00	00.84	00.196	21.14	0.73	1.21	1.11	000.000	00.000
10.30	011	076	162	00.43	0.00	0000	0000	0.13	0.00	00.75	00.137	21.14	0.86	1.22	1.07	000.000	00.000
11.00	011	074	155	00.42	0.00	0000	0000	0.13	0.00	00.73	00.121	21.13	0.91	1.15	1.09	000.000	00.000
11.30	011	070	149	00.41	0.00	0000	0000	0.12	0.00	00.65	00.125	21.14	0.88	1.23	1.08	000.000	00.000
12.00	011	069	143	00.43	0.00	0000	0000	0.12	0.00	00.00	00.147	21.14	0.81	1.15	1.04	000.000	00.000
12.30	011	067	137	00.41	0.00	0000	0000	0.12	0.00	00.00	00.181	21.14	0.52	1.11	0.97	000.000	00.000
13.00	011	065	132	00.39	0.00	0000	0000	0.11	0.00	00.00	00.295	21.14	0.57	1.13	0.93	000.000	00.000
13.30	011	063	129	00.39	0.00	0000	0000	0.11	0.00	00.00	00.064	21.14	0.84	1.16	0.97	000.000	00.000
14.00	011	061	124	00.37	0.00	0000	0000	0.11	0.00	00.00	00.065	21.13	0.83	1.18	0.75	000.000	00.000
14.30	011	059	119	00.37	0.00	0000	0000	0.11	0.00	00.00	00.074	21.14	0.73	1.16	0.75	000.000	00.000
15.00	011	059	116	00.37	0.00	0000	0000	0.11	0.00	00.00	00.076	21.13	0.85	1.12	0.74	000.000	00.000
15.30	011	057	113	00.37	0.00	0000	0000	0.11	0.00	00.00	00.075	21.14	0.62	1.10	0.93	000.000	00.000
16.00	011	057	110	00.37	0.00	0000	0000	0.10	0.00	00.00	00.075	21.14	0.86	1.14	0.91	000.000	00.000
16.30	011	055	106	00.33	0.00	0000	0000	0.10	0.00	00.00	00.075	21.13	0.66	1.13	0.91	000.000	00.000
17.00	011	054	103	00.36	0.00	0000	0000	0.10	0.00	00.00	00.074	21.14	0.85	1.10	0.91	000.000	00.000
17.30	011	053	101	00.33	0.00	0000	0000	0.10	0.00	00.00	00.073	21.13	0.85	1.12	0.91	000.000	00.000
18.00	011	052	099	00.37	0.00	0000	0000	0.10	0.00	00.00	00.073	21.13	0.85	1.09	0.90	000.000	00.000
19.30	011	050	095	00.36	0.00	0000	0000	0.10	0.00	00.00	00.072	21.13	0.60	1.06	0.88	000.000	00.000
19.00	011	049	092	00.37	0.00	0000	0000	0.10	0.00	00.00	00.073	21.13	0.83	1.06	0.89	000.000	00.000
19.30	011	048	090	00.33	0.00	0000	0000	0.10	0.00	00.00	00.076	21.14	0.65	1.09	0.87	000.000	00.000
20.00	011	048	089	00.33	0.00	0000	0000	0.10	0.00	00.00	00.076	21.13	0.85	1.09	0.86	000.000	00.000

TABLE 34: PMMA - 2 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	029	060	00.00	00.0	0000	0000	0.04	0.00	00.00	00.000	18.79	0.00	0.00	0.00	000.000	00.000
00.30	014	007	127	00.46	00.1	0000	0000	0.05	0.00	00.00	00.000	18.71	0.00	0.00	0.00	000.000	00.000
01.00	014	113	171	00.59	00.0	0000	0000	0.06	0.00	00.54	00.000	16.60	0.00	0.00	0.00	000.000	00.000
01.30	014	155	250	00.66	00.0	0000	0000	0.09	0.00	01.10	00.000	18.07	0.00	0.00	0.00	000.000	00.000
02.00	014	191	313	00.74	00.6	0001	0000	0.12	0.00	01.38	00.000	17.60	0.00	0.00	0.00	000.000	00.000
02.30	014	212	320	00.85	01.6	0004	0000	0.17	0.00	02.66	00.000	16.37	0.00	0.00	0.00	000.000	00.000
03.00	014	242	378	00.97	02.7	0008	0002	0.23	0.00	03.45	00.000	16.52	0.00	0.00	0.00	000.000	00.000
03.30	014	279	495	01.01	06.7	0019	0009	0.33	0.00	02.97	00.120	16.04	0.00	0.00	0.00	000.000	00.000
04.00	014	303	594	01.13	05.1	0018	0019	0.41	0.00	03.68	00.124	16.13	0.00	0.00	0.00	000.000	00.000
04.30	014	329	608	01.11	03.7	0013	0031	0.45	0.00	04.56	00.131	15.27	0.00	0.00	0.00	000.000	00.000
05.00	014	313	534	00.94	02.5	0007	0041	0.45	0.00	06.12	00.144	14.21	0.00	0.00	0.00	000.000	00.000
05.30	014	239	333	00.95	02.0	0005	0045	0.39	0.00	05.18	00.138	13.44	0.00	0.00	0.00	000.000	00.000
06.00	014	184	238	00.86	00.4	0001	0045	0.31	0.00	02.31	00.12	14.34	0.00	0.00	0.00	000.000	00.000
06.30	014	148	204	00.74	00.0	0000	0045	0.23	0.00	01.19	00.110	16.75	0.00	0.00	0.00	000.000	00.000
07.00	014	120	186	00.63	00.0	0000	0045	0.17	0.00	00.57	00.107	17.71	0.00	0.00	0.00	000.000	00.000
07.30	014	108	164	00.57	00.0	0000	0045	0.15	0.00	00.14	00.105	18.37	0.00	0.00	0.00	000.000	00.000
08.00	014	095	146	00.57	00.0	0000	0045	0.14	0.00	00.00	00.1	18.77	0.00	0.00	0.00	000.000	00.000

TABLE 35: PMMA - 2 m corridor - 10 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	003	024	00.05	0.00	0000	0000	0.11	0.00	00.00	00.006	21.11	0.00	0.00	0.00	000.000	00.000
00.30	010	035	113	00.36	0.00	0000	0000	0.12	0.00	00.00	00.002	21.10	0.00	0.00	0.00	000.000	00.000
01.00	010	045	122	00.35	0.00	0000	0000	0.11	0.00	00.00	00.001	21.10	0.00	0.00	0.00	000.000	00.000
01.30	010	075	203	00.14	0.00	0000	0000	0.12	0.00	00.00	00.002	21.10	0.00	0.00	0.00	000.000	00.000
02.00	010	106	252	00.47	0.00	0000	0000	0.13	0.00	00.46	00.006	21.19	0.01	0.00	0.00	000.000	00.000
02.30	010	136	315	00.54	0.00	0000	0000	0.14	0.00	00.71	00.035	21.00	0.01	0.00	0.01	000.000	00.000
03.00	010	157	412	00.33	0.00	0000	0000	0.16	0.00	01.21	00.234	15.12	0.02	0.01	0.01	000.000	00.000
03.30	010	204	537	00.63	0.00	0000	0000	0.19	0.00	02.28	00.406	13.60	0.03	0.02	0.02	000.000	00.000
04.00	010	245	753	00.67	0.00	0000	0000	0.23	0.00	03.63	00.475	12.76	0.05	0.03	0.04	000.000	00.000
04.30	010	355	769	00.63	0.00	0000	0000	0.62	0.00	05.31	00.575	11.53	0.45	0.12	0.21	000.000	00.000
05.00	010	311	328	00.57	0.00	0000	0000	0.33	0.00	09.52	00.349	10.76	1.09	0.71	0.35	000.000	00.000
05.30	010	276	544	00.63	0.00	0000	0000	0.45	0.00	03.74	00.224	12.36	1.26	1.24	1.33	000.000	00.000
06.00	010	226	419	00.56	0.00	0000	0000	0.31	0.00	03.42	00.071	14.54	1.22	1.06	1.16	000.000	00.000
06.30	010	175	314	00.55	0.00	0000	0000	0.27	0.00	01.77	00.072	15.37	0.33	1.13	1.00	000.000	00.000
07.00	010	153	263	00.55	0.00	0000	0000	0.24	0.00	01.53	00.072	17.11	0.24	1.30	1.00	000.000	00.000
07.30	010	141	223	00.51	0.00	0000	0000	0.22	0.00	00.40	00.072	19.32	0.54	1.09	1.03	000.000	00.000
08.00	010	129	199	00.50	0.00	0000	0000	0.20	0.00	00.03	00.103	20.33	0.55	1.13	1.12	000.000	00.000
08.30	010	120	180	00.47	0.00	0000	0000	0.19	0.00	00.00	00.100	20.39	0.99	1.10	1.03	000.000	00.000
09.00	010	112	166	00.49	0.00	0000	0000	0.18	0.00	00.00	00.100	20.99	0.74	1.00	0.73	000.000	00.000
09.30	010	105	157	00.41	0.00	0000	0000	0.15	0.00	00.00	00.102	21.23	0.76	1.12	0.75	000.000	00.000
10.00	010	099	147	00.42	0.00	0000	0000	0.17	0.00	00.00	00.102	21.04	0.77	1.45	0.72	000.000	00.000
10.30	010	094	137	00.42	0.00	0000	0000	0.16	0.00	00.00	00.105	21.07	0.83	1.16	0.96	000.000	00.000
11.00	010	089	130	00.40	0.00	0000	0000	0.16	0.00	00.00	00.105	21.07	0.89	1.14	0.98	000.000	00.000
11.30	010	085	124	00.40	0.00	0000	0000	0.16	0.00	00.00	00.107	21.07	0.91	1.11	0.93	000.000	00.000
12.00	010	081	119	00.40	0.00	0000	0000	0.15	0.00	00.00	00.107	21.08	0.91	1.11	0.97	000.000	00.000
12.30	010	078	112	00.44	0.00	0000	0000	0.15	0.00	00.00	00.111	21.07	0.65	1.12	0.93	000.000	00.000
13.00	010	075	107	00.42	0.00	0000	0000	0.15	0.00	00.00	00.110	21.06	0.64	1.04	0.79	000.000	00.000
13.30	010	072	104	00.43	0.00	0000	0000	0.14	0.00	00.00	00.112	21.06	0.75	1.04	0.99	000.000	00.000
14.00	010	069	101	00.42	0.00	0000	0000	0.14	0.00	00.00	00.111	21.05	0.65	1.04	0.93	000.000	00.000
14.30	010	067	096	00.41	0.00	0000	0000	0.14	0.00	00.00	00.073	21.04	0.73	0.99	0.97	000.000	00.000
15.00	010	065	093	00.40	0.00	0000	0000	0.14	0.00	00.00	00.006	21.33	0.77	0.76	0.95	000.472	00.000
15.30	010	063	091	00.35	0.00	0000	0000	0.13	0.00	00.00	00.097	21.04	0.79	0.76	0.93	000.000	00.000
16.00	010	061	087	00.35	0.00	0000	0000	0.13	0.00	00.00	00.106	21.03	0.75	0.76	0.92	000.000	00.000
16.30	010	059	084	00.34	0.00	0000	0000	0.14	0.00	00.00	00.105	21.02	0.73	0.74	0.91	000.000	00.000
17.00	010	057	082	00.37	0.00	0000	0000	0.13	0.00	00.00	00.107	21.03	0.77	0.74	0.89	000.000	00.000
17.30	010	056	079	00.37	0.00	0000	0000	0.13	0.00	00.00	00.098	21.03	0.75	0.71	0.87	000.000	00.000
18.00	010	054	077	00.35	0.00	0000	0000	0.13	0.00	00.00	00.057	21.04	0.76	0.73	0.89	000.000	00.000
18.30	010	053	075	00.36	0.00	0000	0000	0.13	0.00	00.00	00.062	21.03	0.73	0.73	0.86	000.000	00.000
19.00	010	051	073	00.34	0.00	0000	0000	0.13	0.00	00.00	00.085	21.02	0.73	0.72	0.85	000.000	00.000
19.30	010	050	071	00.34	0.00	0000	0000	0.13	0.00	00.00	00.096	21.02	0.79	0.39	0.83	000.000	00.000
20.00	010	049	070	00.35	0.00	0000	0000	0.13	0.00	00.00	00.101	21.01	0.76	0.39	0.82	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	019	127	00.00	0.00	0000	0000	0.08	0.00	00.00	00.073	20.74	0.00	0.00	0.00	001.152	00.000
00.30	010	029	077	00.06	0.51	0000	0000	0.02	0.00	00.00	00.087	20.36	0.00	0.00	0.00	000.935	00.000
01.00	010	046	085	00.16	0.00	0000	0000	0.09	0.00	00.00	00.084	20.34	0.00	0.00	0.00	000.937	00.000
01.30	010	060	113	00.23	0.00	0000	0000	0.07	0.00	00.00	00.056	20.86	0.00	0.00	0.00	000.925	00.000
02.00	010	089	154	00.29	0.00	0000	0000	0.08	0.00	00.00	00.053	20.36	0.00	0.00	0.00	000.909	00.000
02.30	010	116	204	00.34	0.00	0000	0000	0.08	0.00	00.00	00.082	20.33	0.00	0.00	0.00	000.941	00.000
03.00	010	147	244	00.36	0.00	0000	0000	0.09	0.00	00.00	00.087	20.76	0.01	0.00	0.00	000.364	00.000
03.30	010	206	337	00.38	0.00	0000	0000	0.10	0.00	00.00	00.091	20.74	0.02	0.00	0.01	000.252	00.000
04.00	010	252	589	00.44	0.00	0000	0000	0.11	0.00	00.05	00.089	20.79	0.03	0.02	0.02	000.215	00.000
04.30	010	279	737	00.47	0.00	0000	0000	0.14	0.00	00.15	00.091	20.55	0.07	0.07	0.04	000.774	00.000
05.00	010	329	751	00.55	0.00	0000	0000	0.29	0.00	00.23	00.072	20.52	0.19	0.09	0.09	000.664	00.000
05.30	011	364	764	00.55	0.00	0000	0000	0.33	0.00	00.55	00.374	20.25	1.21	0.62	0.32	000.643	00.000
06.00	011	392	761	00.55	0.00	0000	0000	0.25	0.00	00.77	00.095	19.54	1.80	1.27	1.40	000.607	00.000
06.30	011	391	593	00.50	0.00	0000	0000	0.12	0.00	01.89	00.146	18.19	1.72	1.43	1.27	000.592	00.000
07.00	010	373	378	00.48	0.00	0000	0000	0.15	0.00	02.74	00.192	16.29	1.23	1.34	1.27	000.579	00.000
07.30	010	352	317	00.43	0.00	0000	0000	0.13	0.00	07.22	00.296	12.91	1.20	1.34	1.14	000.591	00.000
08.00	010	311	277	00.43	0.00	0000	0000	0.13	0.00	05.36	01.266	13.45	1.35	1.41	1.30	000.599	00.000
08.30	010	226	247	00.40	0.00	0000	0000	0.12	0.00	05.29	00.009	20.32	1.12	1.31	1.25	000.567	00.000
09.00	010	169	224	00.38	0.00	0000	0000	0.12	0.00	00.39	00.274	20.66	1.13	1.32	1.34	000.611	00.000
09.30	010	144	209	00.42	0.00	0000	0000	0.11	0.00	00.00	00.091	20.75	1.13	1.31	1.19	000.615	00.000
10.00	010	138	191	00.40	0.00	0000	0000	0.11	0.00	00.21	00.068	20.78	1.15	1.35	1.24	000.624	00.000
10.30	010	134	130	00.38	0.00	0000	0000	0.11	0.00	00.00	00.054	20.79	1.14	1.33	1.22	000.624	00.000
11.00	010	129	170	00.36	0.00	0000	0000	0.10	0.00	00.00	00.085	20.79	1.07	1.39	1.19	000.632	00.000
11.30	010	122	161	00.37	0.00	0000	0000	0.10	0.00	00.00	00.066	20.77	0.77	1.36	1.24	000.536	00.000
12.00	010	117	153	00.38	0.00	0000	0000	0.10	0.00	00.00	00.086	20.80	0.98	1.36	1.23	000.640	00.000
12.30	010	113	149	00.34	0.00	0000	0000	0.10	0.00	00.00	00.083	20.77	0.90	1.37	1.20	000.644	00.000
13.00	010	108	143	00.37	0.00	0000	0000	0.10	0.00	00.00	00.084	20.79	0.82	1.19	1.15	000.648	00.000
13.30	010	103	137	00.35	0.00	0000	0000	0.10	0.00	00.00	00.083	20.77	0.64	1.27	1.21	000.652	00.000
14.00	010	099	131	00.34	0.00	0000	0000	0.10	0.00	00.00	00.099	20.75	0.73	1.18	1.17	000.652	00.000
14.30	010	096	127	00.34	0.00	0000	0000	0.10	0.00	00.00	00.112	20.66	0.74	1.14	1.16	000.656	00.000
15.00	010	089	121	00.33	0.00	0000	0000	0.10	0.00	00.00	00.104	20.53	0.80	1.19	1.14	000.664	00.000
15.30	010	085	116	00.34	0.00	0000	0000	0.09	0.00	00.00	00.096	20.60	0.78	1.11	1.11	000.664	00.000
16.00	010	082	112	00.33	0.00	0000	0000	0.09	0.00	00.00	00.075	20.70	0.83	1.14	1.10	000.668	00.000
16.30	010	079	110	00.33	0.00	0000	0000	0.10	0.00	00.00	00.077	20.76	0.34	1.16	1.10	000.661	00.000
17.00	010	075	106	00.32	0.00	0000	0000	0.09	0.00	00.00	00.084	20.88	0.85	1.13	1.08	000.631	00.000
17.30	010	071	103	00.31	0.00	0000	0000	0.09	0.00	00.00	00.075	20.88	0.83	1.06	1.09	000.661	00.000
18.00	010	069	099	00.32	0.00	0000	0000	0.07	0.00	00.00	00.077	20.72	0.83	1.13	1.10	000.655	00.000
18.30	010	066	096	00.31	0.00	0000	0000	0.09	0.00	00.00	00.080	20.71	0.57	1.07	1.08	000.655	00.000
19.00	010	065	094	00.32	0.00	0000	0000	0.09	0.00	00.00	00.082	20.67	0.88	1.10	1.08	000.673	00.000
19.30	010	063	092	00.30	0.00	0000	0000	0.09	0.00	00.00	00.081	20.68	0.86	1.11	1.06	000.673	00.000
20.00	010	062	088	00.30	0.00	0000	0000	0.09	0.00	00.00	00.081	20.91	0.82	1.09	1.05	000.697	00.000

TABLE 35: PMMA - 2 m corridor - 10 cm opening (cont.)

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	019	036	00.00	00.0	0000	0000	0.08	0.00	00.00	00.095	18.32	0.00	0.00	0.00	000.000	00.000
00.30	014	065	147	00.23	00.1	0000	0000	0.08	0.00	00.00	00.094	18.22	0.00	0.00	0.00	000.000	00.000
01.00	014	084	194	00.38	00.0	0000	0000	0.08	0.00	00.63	00.106	18.07	0.00	0.00	0.00	000.000	00.000
01.30	014	118	259	00.44	00.0	0000	0000	0.15	0.00	01.08	00.103	17.79	0.00	0.00	0.00	000.000	00.000
02.00	014	146	316	00.44	00.0	0000	0000	0.15	0.00	01.74	00.102	17.75	0.00	0.00	0.00	000.000	00.000
02.30	014	158	474	00.54	00.3	0001	0000	0.33	0.00	02.24	00.106	17.22	0.00	0.00	0.00	000.000	00.000
03.00	014	235	559	00.61	03.4	0006	0002	0.43	0.00	03.37	00.111	16.09	0.00	0.00	0.00	000.000	00.000
03.30	014	287	754	00.81	19.7	0046	0012	0.52	0.00	04.86	00.113	15.47	0.00	0.00	0.00	000.000	00.000
04.00	014	320	795	00.72	23.0	0053	0039	0.56	0.00	07.76	00.215	14.15	0.00	0.00	0.00	000.000	00.000
04.30	014	311	746	00.74	05.1	0012	0063	0.21	0.00	11.46	01.639	10.70	0.00	0.00	0.00	000.000	00.000
05.00	014	248	447	00.61	00.8	0001	0070	0.13	0.00	08.62	00.567	08.16	0.00	0.00	0.00	000.000	00.000
05.30	014	193	366	00.61	00.7	0001	0070	0.12	0.00	01.96	00.191	11.71	0.00	0.00	0.00	000.000	00.000
06.00	014	166	309	00.55	00.5	0001	0070	0.11	0.00	00.51	00.142	16.82	0.00	0.00	0.00	000.000	00.000
06.30	014	149	273	00.54	01.3	0002	0070	0.10	0.00	00.09	00.114	18.18	0.00	0.00	0.00	000.000	00.000
07.00	014	136	245	00.53	00.6	0001	0070	0.10	0.00	00.00	00.104	18.53	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	036	055	00.00	00.0	0000	0000	0.08	0.00	00.00	00.101	19.00	0.00	0.00	0.00	000.000	00.000
00.30	014	058	113	00.36	00.0	0000	0000	0.08	0.00	00.00	00.103	18.93	0.00	0.00	0.00	000.000	00.000
01.00	014	071	123	00.38	00.0	0000	0000	0.05	0.00	00.46	00.110	18.30	0.00	0.00	0.00	000.000	00.000
01.30	014	086	152	00.41	00.0	0000	0000	0.08	0.00	00.52	00.108	18.77	0.00	0.00	0.00	000.000	00.000
02.00	014	136	272	00.51	00.0	0000	0000	0.09	0.00	00.37	00.114	18.26	0.00	0.00	0.00	000.000	00.000
02.30	014	178	438	00.54	00.6	0001	0000	0.10	0.00	01.86	00.118	17.22	0.00	0.00	0.00	000.000	00.000
03.00	014	237	597	00.68	06.2	0011	0003	0.12	0.00	03.50	00.120	17.02	0.00	0.00	0.00	000.000	00.000
03.30	014	281	752	00.72	35.7	0076	0021	0.19	0.00	05.34	00.129	15.29	0.00	0.00	0.00	000.000	00.000
04.00	014	324	824	00.71	30.4	0065	0052	0.25	0.00	07.90	00.241	13.47	0.00	0.00	0.00	000.000	00.000
04.30	014	290	621	00.71	02.4	0005	0067	0.17	0.00	10.29	01.354	10.56	0.00	0.00	0.00	000.000	00.000
05.00	014	212	425	00.61	00.4	0001	0067	0.12	0.00	06.15	00.300	09.21	0.00	0.00	0.00	000.000	00.000
05.30	014	173	320	00.56	00.0	0000	0067	0.11	0.00	01.16	00.130	14.01	0.00	0.00	0.00	000.000	00.000
06.00	014	158	271	00.53	00.2	0000	0067	0.11	0.00	00.24	00.133	17.22	0.00	0.00	0.00	000.000	00.000
06.30	014	144	257	00.47	00.0	0000	0067	0.10	0.00	00.00	00.117	18.53	0.00	0.00	0.00	000.000	00.000

TABLE 36: PMMA - 4 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	025	080	00.30	00.0	0000	0000	0.11	0.00	00.00	00.063	20.90	0.00	0.00	0.00	000.000	00.000
00.30	011	033	112	00.53	00.0	0000	0000	0.14	0.00	00.00	00.063	21.21	0.00	0.00	0.00	000.000	00.000
01.00	011	035	155	00.69	00.0	0000	0000	0.16	0.00	00.00	00.061	20.92	0.00	0.00	0.00	000.000	00.000
01.30	011	046	204	00.61	00.5	0001	0000	0.20	0.00	00.13	00.066	21.20	0.00	0.00	0.00	000.000	00.000
02.00	011	052	221	00.77	00.3	0001	0000	0.24	0.00	00.45	00.066	20.47	0.00	0.00	0.00	000.000	00.000
02.30	011	057	274	00.91	02.5	0004	0000	0.30	0.00	00.95	00.070	20.12	0.00	0.00	0.00	000.000	00.000
03.00	011	064	310	01.02	03.5	0005	0004	0.37	0.00	01.36	00.072	19.71	0.00	0.00	0.00	000.000	00.000
03.30	011	063	357	01.10	06.7	0014	0010	0.43	0.00	01.76	00.072	19.21	0.00	0.00	0.00	000.000	00.000
04.00	011	071	425	01.10	08.9	0018	0019	0.29	0.00	02.25	00.076	18.51	0.00	0.00	0.00	000.000	00.000
04.30	011	073	517	01.26	10.3	0023	0030	0.21	0.00	02.68	00.076	17.64	0.00	0.00	0.00	000.000	00.000
05.00	011	196	529	01.00	11.7	0025	0037	0.18	0.00	03.18	00.073	17.12	0.00	0.00	0.00	000.000	00.000
05.30	011	172	374	01.17	06.8	0015	0052	0.16	0.00	04.23	00.064	16.38	0.00	0.00	0.00	000.000	00.000
06.00	011	158	237	00.98	02.4	0000	0057	0.15	0.00	05.33	00.063	15.24	0.00	0.00	0.00	000.000	00.000
06.30	011	145	222	00.24	00.7	0001	0057	0.14	0.00	03.39	00.057	14.51	0.00	0.00	0.00	000.000	00.000
07.00	011	139	214	00.79	00.5	0001	0057	0.13	0.00	01.99	00.076	16.37	0.00	0.00	0.00	000.000	00.000
07.30	011	133	207	00.71	00.5	0001	0057	0.13	0.00	00.73	00.067	18.37	0.00	0.00	0.00	000.000	00.000
08.00	011	126	193	00.64	00.3	0000	0057	0.13	0.00	00.77	00.066	19.30	0.00	0.00	0.00	000.000	00.000
08.30	011	129	182	00.60	00.4	0000	0057	0.12	0.00	00.98	00.052	20.37	0.00	0.00	0.00	000.000	00.000

TABLE 37: PMMA - 4 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	017	024	00.00	00.3	0000	0000	0.08	0.00	00.00	00.069	21.19	0.00	0.00	0.00	000.000	00.000
00.30	010	023	074	00.39	00.0	0000	0000	0.10	0.00	00.00	00.068	20.37	0.00	0.00	0.00	000.000	00.000
01.00	010	024	096	00.41	00.1	0000	0000	0.10	0.00	00.00	00.067	20.39	0.00	0.00	0.00	000.000	00.000
01.30	010	027	147	00.44	00.1	0000	0000	0.12	0.00	00.10	00.071	21.13	0.00	0.00	0.00	000.000	00.000
02.00	010	032	235	00.53	00.1	0000	0000	0.15	0.00	00.23	00.077	20.72	0.00	0.00	0.00	000.000	00.000
02.30	010	040	357	00.59	00.4	0000	0000	0.17	0.00	00.43	00.075	20.17	0.00	0.00	0.00	000.000	00.000
03.00	010	048	554	00.67	03.3	0004	0000	0.24	0.00	00.85	00.081	19.74	0.00	0.00	0.00	000.000	00.000
03.30	010	146	757	00.88	06.1	0009	0003	0.33	0.00	01.44	00.059	19.57	0.00	0.00	0.00	000.000	00.000
04.00	010	150	890	00.72	40.2	0047	0025	0.44	0.00	02.37	00.027	18.33	0.00	0.00	0.00	000.000	00.000
04.30	010	157	821	00.65	37.7	0059	0075	0.46	0.00	03.78	00.091	17.72	0.00	0.00	0.00	000.000	00.000
05.00	010	181	715	00.64	36.5	0010	0089	0.37	0.00	06.20	00.175	15.72	0.00	0.00	0.00	000.000	00.000
05.30	010	154	324	00.63	02.5	0004	0092	0.24	0.00	07.54	01.251	12.14	0.00	0.00	0.00	000.000	00.000
06.00	010	129	279	00.57	03.4	0004	0093	0.20	0.00	05.77	00.477	14.55	0.00	0.00	0.00	000.000	00.000
06.30	010	112	259	00.55	02.2	0003	0093	0.18	0.00	01.32	00.157	15.40	0.00	0.00	0.00	000.000	00.000
07.00	010	142	225	00.53	01.4	0001	0093	0.16	0.00	00.74	00.099	19.21	0.00	0.00	0.00	000.000	00.000
07.30	010	094	206	00.44	00.9	0001	0093	0.16	0.00	00.32	00.053	20.16	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	*CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	010	025	069	00.00	00.0	0000	0000	0.12	0.00	00.00	00.077	21.14	0.00	0.00	0.00	000.000	00.000
00.30	010	036	097	00.44	00.1	0000	0000	0.28	0.00	00.00	00.077	21.04	0.00	0.00	0.00	000.000	00.000
01.00	010	049	099	00.45	00.1	0000	0000	0.40	0.00	00.00	00.077	21.14	0.00	0.00	0.00	000.000	00.000
01.30	010	067	132	00.52	00.2	0000	0000	0.49	0.00	00.17	00.227	20.75	0.00	0.00	0.00	000.000	00.000
02.00	010	089	166	00.54	00.0	0000	0000	0.49	0.00	00.10	00.085	20.63	0.00	0.00	0.00	000.000	00.000
02.30	010	119	235	00.64	00.0	0000	0000	0.10	0.00	00.29	00.033	20.55	0.00	0.00	0.00	000.000	00.000
03.00	010	131	317	00.56	01.2	0001	0006	0.20	0.00	00.52	00.055	20.48	0.00	0.00	0.00	000.000	00.000
03.30	010	148	411	00.65	05.6	0004	0000	0.31	0.00	01.06	00.091	19.77	0.00	0.00	0.00	000.000	00.000
04.00	010	169	604	00.69	13.0	0016	0005	0.52	0.00	01.77	00.085	19.28	0.00	0.00	0.00	000.000	00.000
04.30	010	253	651	00.80	62.6	0101	0045	0.63	0.00	02.61	00.035	18.53	0.00	0.00	0.00	000.000	00.000
05.00	010	274	618	00.85	19.7	0030	0090	0.58	0.00	04.74	00.059	17.27	0.00	0.00	0.00	000.000	00.000
05.30	010	282	416	00.79	06.5	0009	0093	0.38	0.00	07.39	00.345	14.23	0.00	0.00	0.00	000.000	00.000
06.00	010	291	323	00.64	02.6	0003	0095	0.27	0.00	08.56	01.349	09.97	0.00	0.00	0.00	000.000	00.000
06.30	010	265	280	00.59	02.1	0003	0099	0.23	0.00	02.77	00.287	11.08	0.00	0.00	0.00	000.000	00.000
07.00	010	242	249	00.57	00.9	0001	0098	0.22	0.00	00.62	00.159	17.32	0.00	0.00	0.00	000.000	00.000
07.30	010	161	225	00.52	00.7	0001	0093	0.20	0.00	00.38	00.110	19.77	0.00	0.00	0.00	000.000	00.000
08.00	010	136	226	00.56	00.6	0001	0099	0.19	0.00	00.00	00.095	20.73	0.00	0.00	0.00	000.000	00.000

TABLE 38: Polypropylene - free burning.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
00.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
01.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
01.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
02.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
02.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
03.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.00	0.00	000.000	00.000
03.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.00	0.01	0.05	000.000	00.000
04.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.05	0.11	0.24	000.000	00.000
04.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.27	0.32	0.39	000.000	00.000
05.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.48	0.57	0.58	000.000	00.000
05.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.71	0.79	0.78	000.000	00.000
06.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.03	0.98	0.89	000.000	00.000
06.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.07	1.06	1.00	000.000	00.000
07.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.98	1.04	0.99	000.000	00.000
07.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	0.89	1.09	0.99	000.000	00.000
08.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.07	1.20	1.93	000.000	00.000
08.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.12	1.17	1.02	000.000	00.000
09.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.10	1.24	1.93	000.000	00.000
09.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.17	1.25	1.05	000.000	00.000
10.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.13	1.37	1.05	000.000	00.000
10.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.12	1.32	0.99	000.000	00.000
11.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.12	1.19	0.95	000.000	00.000
11.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.18	1.16	0.99	000.000	00.000
12.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.22	1.14	0.92	000.000	00.000
12.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.15	0.96	0.89	000.000	00.000
13.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.14	1.02	0.98	000.000	00.000
13.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.29	1.17	0.88	000.000	00.000
14.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.26	1.12	0.94	000.000	00.000
14.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.23	1.07	0.72	000.000	00.000
15.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.22	1.07	0.84	000.000	00.000
15.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.23	1.07	0.88	000.000	00.000
16.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.20	1.00	0.70	000.000	00.000
16.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.21	1.04	0.89	000.000	00.000
17.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.20	1.03	0.70	000.000	00.000
17.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.20	0.98	0.59	000.000	00.000
18.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.19	1.00	0.28	000.000	00.000
18.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.18	0.76	0.29	000.000	00.000
19.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.15	0.76	0.36	000.000	00.000
19.30	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.09	0.75	0.86	000.000	00.000
20.00	000	000	000	00.00	0.00	0000	0000	0.00	0.00	00.00	00.000	00.00	1.05	0.96	0.86	000.000	00.000

TABLE 39: Polypropylene - box only - 10 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	009	000	057	00.00	0.00	0000	0000	0.18	0.00	00.00	00.000	20.70	0.00	0.00	0.00	000.000	00.000
00.30	009	000	116	00.00	0.00	0000	0000	0.24	0.00	00.00	00.000	20.89	0.00	0.00	0.00	000.000	00.000
01.00	009	000	096	00.00	0.00	0000	0000	0.21	0.00	00.00	00.000	20.54	0.00	0.00	0.00	000.000	00.000
01.30	009	000	102	00.00	0.00	0000	0000	0.20	0.00	00.00	00.000	20.13	0.00	0.00	0.00	000.000	00.000
02.00	009	000	128	00.00	0.00	0000	0000	0.28	0.00	00.00	00.000	19.83	0.00	0.00	0.00	000.000	00.000
02.30	009	000	154	00.00	0.00	0000	0000	0.35	0.00	00.00	00.000	19.13	0.00	0.00	0.00	000.000	00.000
03.00	009	000	180	00.00	0.00	0000	0000	0.41	0.00	00.00	00.000	18.48	0.00	0.00	0.00	000.000	00.000
03.30	009	000	223	00.00	0.00	0000	0000	0.54	0.00	00.00	00.000	17.78	0.00	0.00	0.01	000.000	00.000
04.00	009	000	282	00.00	0.00	0000	0000	0.75	0.00	00.00	00.000	16.44	0.00	0.00	0.02	000.000	00.000
04.30	009	000	364	00.00	0.00	0000	0000	1.09	0.00	00.00	00.000	14.77	0.02	0.02	0.05	000.000	00.000
05.00	009	000	619	00.00	0.00	0000	0000	3.03	0.00	00.00	00.000	13.23	0.11	0.19	0.17	000.000	00.000
05.30	009	000	715	00.00	0.00	0000	0000	2.54	0.00	00.00	00.000	06.52	1.11	0.83	1.00	000.000	00.000
06.00	009	000	364	00.00	0.00	0000	0000	1.11	0.00	00.00	00.000	07.51	1.19	1.32	1.74	000.000	00.000
06.30	009	000	272	00.00	0.00	0000	0000	0.63	0.00	00.00	00.112	06.66	1.34	1.43	1.28	000.000	00.000
07.00	009	000	223	00.00	0.00	0000	0000	0.45	0.00	08.23	00.139	05.11	1.17	1.26	1.16	000.000	00.000
07.30	009	000	191	00.00	0.00	0000	0000	0.36	0.00	10.36	01.261	05.75	1.27	1.24	1.15	000.000	00.000
08.00	010	000	171	00.00	0.00	0000	0000	0.30	0.00	00.92	01.529	18.36	1.34	1.33	1.06	000.000	00.000
08.30	010	000	155	00.00	0.00	0000	0000	0.27	0.00	00.90	01.522	19.03	1.36	1.28	1.03	000.000	00.000
09.00	010	000	140	00.00	0.00	0000	0000	0.23	0.00	00.09	01.436	19.33	1.36	1.40	1.01	000.000	00.000
09.30	010	000	130	00.00	0.00	0000	0000	0.22	0.00	00.00	01.275	19.48	1.33	1.23	0.95	000.000	00.000
10.00	010	000	121	00.00	0.00	0000	0000	0.20	0.00	00.00	00.973	19.57	1.23	1.26	0.97	000.000	00.000
10.30	010	000	113	00.00	0.00	0000	0000	0.18	0.00	00.00	00.105	19.66	1.30	1.26	1.02	000.000	00.000
11.00	010	000	106	00.00	0.00	0000	0000	0.18	0.00	00.00	00.106	19.75	1.18	1.26	0.91	000.000	00.000
11.30	010	000	099	00.00	0.00	0000	0000	0.17	0.00	00.00	00.102	19.81	1.25	1.14	0.85	000.000	00.000
12.00	009	000	096	00.00	0.00	0000	0000	0.16	0.00	00.00	00.104	19.90	1.13	1.16	0.88	000.000	00.000
12.30	010	000	099	00.00	0.00	0000	0000	0.15	0.00	00.00	00.103	20.00	1.18	1.18	0.85	000.000	00.000
13.00	010	000	087	00.00	0.00	0000	0000	0.14	0.00	00.00	00.099	20.07	1.16	1.18	0.90	000.000	00.000
13.30	010	000	092	00.00	0.00	0000	0000	0.14	0.00	00.00	00.096	20.18	1.17	1.23	0.91	000.000	00.000
14.00	010	000	079	00.00	0.00	0000	0000	0.13	0.00	00.00	00.094	20.24	1.09	1.23	0.86	000.000	00.000
14.30	010	000	076	00.00	0.00	0000	0000	0.13	0.00	00.00	00.096	20.28	1.15	1.15	0.87	000.000	00.000
15.00	009	000	073	00.00	0.00	0000	0000	0.12	0.00	00.00	00.098	20.31	1.18	1.15	0.83	000.000	00.000
15.30	010	000	070	00.00	0.00	0000	0000	0.12	0.00	00.00	00.092	20.34	1.09	1.20	0.77	000.000	00.000
16.00	010	000	068	00.00	0.00	0000	0000	0.12	0.00	00.00	00.093	20.38	1.14	1.14	0.77	000.000	00.000
16.30	010	000	066	00.00	0.00	0000	0000	0.12	0.00	00.00	00.090	20.42	1.15	1.14	0.74	000.000	00.000
17.00	010	000	063	00.00	0.00	0000	0000	0.11	0.00	00.00	00.095	20.44	1.13	1.08	0.72	000.000	00.000
17.30	010	000	061	00.00	0.00	0000	0000	0.12	0.00	00.00	00.094	20.44	1.17	1.04	0.73	000.000	00.000
18.00	010	000	059	00.00	0.00	0000	0000	0.11	0.00	00.00	00.094	20.48	1.16	1.05	0.73	000.000	00.000
18.30	010	000	057	00.00	0.00	0000	0000	0.11	0.00	00.00	00.099	20.49	1.16	1.03	0.72	000.000	00.000
19.00	009	000	055	00.00	0.00	0000	0000	0.11	0.00	00.00	00.097	20.50	1.14	1.02	0.74	000.000	00.000
19.30	010	000	054	00.00	0.00	0000	0000	0.11	0.00	00.00	00.091	20.54	1.13	1.00	0.75	000.000	00.000
20.00	009	000	052	00.00	0.00	0000	0000	0.10	0.00	00.00	00.090	20.56	1.12	1.00	0.76	000.000	00.000

TABLE 40: Polypropylene - 1 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	002	034	00.10	0.00	0000	0000	0.08	0.00	00.00	00.384	21.10	0.00	0.00	0.00	000.000	00.000
00.30	010	021	093	00.39	0.00	0000	0000	0.08	0.00	00.00	00.487	21.16	0.00	0.00	0.00	000.000	00.000
01.00	010	024	089	00.36	0.00	0000	0000	0.08	0.00	00.00	00.485	21.12	0.00	0.00	0.00	000.000	00.000
01.30	010	027	062	00.36	0.00	0000	0000	0.08	0.00	00.00	00.485	21.12	0.00	0.00	0.00	000.000	00.000
02.00	010	027	085	00.36	0.00	0000	0000	0.08	0.00	00.00	00.477	21.12	0.00	0.00	0.00	000.000	00.000
02.30	010	027	102	00.33	0.00	0000	0000	0.08	0.00	00.00	00.457	20.98	0.00	0.01	0.00	000.000	00.000
03.00	010	033	123	00.40	0.00	0000	0000	0.09	0.00	00.00	00.465	20.94	0.00	0.00	0.00	000.000	00.000
03.30	010	042	157	00.43	0.00	0000	0000	0.09	0.00	00.00	00.464	20.96	0.00	0.00	0.00	000.000	00.000
04.00	010	054	150	00.45	0.00	0000	0000	0.09	0.00	00.00	00.464	20.95	0.00	0.00	0.01	000.000	00.000
04.30	010	060	253	00.52	0.00	0000	0000	0.10	0.00	00.00	00.463	20.92	0.01	0.01	0.02	000.000	00.000
05.00	010	078	317	00.55	0.00	0000	0000	0.11	0.00	00.00	00.463	20.86	0.03	0.02	0.03	000.000	00.000
05.30	010	119	451	00.57	0.00	0000	0000	0.14	0.00	00.00	[illegible]	20.85	0.07	0.04	0.06	000.000	00.000
06.00	010	267	727	00.56	0.00	0000	0000	0.25	0.00	00.00	[illegible]	20.81	0.46	0.33	0.77	000.000	00.000
06.30	010	493	496	00.51	0.00	0000	0000	0.23	0.00	00.00	00.458	20.61	1.23	1.11	1.06	000.000	00.000
07.00	010	055	338	00.44	0.00	0000	0000	0.16	0.00	00.70	00.352	20.76	1.10	1.10	0.81	000.000	00.000
07.30	010	038	272	00.41	0.00	0000	0000	0.14	0.00	01.24	00.462	20.28	1.03	0.99	0.89	000.000	00.000
08.00	010	034	231	00.40	0.00	0000	0000	0.13	0.00	01.84	00.465	20.47	0.89	0.99	0.85	000.000	00.000
08.30	010	031	203	00.39	0.00	0000	0000	0.12	0.00	02.31	01.022	19.44	0.84	0.94	0.25	000.000	00.000
09.00	010	029	184	00.37	0.00	0000	0000	0.12	0.00	02.67	00.345	13.56	0.84	0.96	0.91	000.000	00.000
09.30	010	029	167	00.38	0.00	0000	0000	0.10	0.00	03.35	00.144	12.55	0.90	1.13	0.95	000.000	00.000
10.00	010	026	154	00.37	0.00	0000	0000	0.10	0.00	05.29	00.146	11.60	0.85	1.06	0.96	000.000	00.000
10.30	010	024	143	00.35	0.00	0000	0000	0.11	0.00	07.19	00.136	11.46	0.87	1.09	0.95	000.000	00.000
11.00	010	024	133	00.35	0.00	0000	0000	0.10	0.00	00.69	00.224	11.85	0.86	1.06	0.87	000.000	00.000
11.30	010	023	125	00.35	0.00	0000	0000	0.11	0.00	00.55	00.255	12.23	0.88	0.93	0.85	000.000	00.000
12.00	010	022	119	00.37	0.00	0000	0000	0.10	0.00	00.45	00.276	15.25	0.57	0.90	0.36	000.000	00.000
12.30	010	019	109	00.34	0.00	0000	0000	0.12	0.00	00.43	00.287	16.25	0.85	1.00	0.87	000.000	00.000
13.00	010	021	104	00.34	0.00	0000	0000	0.11	0.00	00.40	00.261	16.33	0.77	0.93	0.82	000.000	00.000
13.30	010	020	101	00.32	0.00	0000	0000	0.12	0.00	00.38	00.249	18.84	0.73	0.95	0.81	000.000	00.000
14.00	010	018	096	00.32	0.00	0000	0000	0.11	0.00	00.30	00.274	18.77	0.73	0.99	0.79	000.000	00.000
14.30	010	020	091	00.33	0.00	0000	0000	0.12	0.00	00.29	00.224	18.36	0.75	1.01	0.79	000.000	00.000
15.00	010	019	089	00.31	0.00	0000	0000	0.11	0.00	00.26	00.215	19.31	0.81	0.93	0.74	000.000	00.000
15.30	010	017	085	00.31	0.00	0000	0000	0.12	0.00	00.00	00.057	19.30	0.74	0.97	0.72	000.000	00.000
16.00	010	017	081	00.32	0.00	0000	0000	0.11	0.00	00.00	00.042	19.39	0.77	0.93	0.68	000.000	00.000
16.30	010	016	079	00.32	0.00	0000	0000	0.11	0.00	00.00	00.037	19.48	0.76	0.95	0.66	000.000	00.000
17.00	010	015	077	00.31	0.00	0000	0000	0.10	0.00	00.00	00.035	19.53	0.76	0.95	0.64	000.000	00.000
17.30	010	016	074	00.29	0.00	0000	0000	0.10	0.00	00.00	00.034	21.09	0.77	0.97	0.64	000.000	00.000
18.00	010	015	071	00.30	0.00	0000	0000	0.11	0.00	00.00	00.038	21.06	0.80	0.97	0.64	000.000	00.000
18.30	010	014	069	00.23	0.00	0000	0000	0.11	0.00	00.00	00.043	21.08	0.79	0.95	0.67	000.000	00.000
19.00	010	014	067	00.23	0.00	0000	0000	0.10	0.00	00.00	00.043	21.08	0.79	0.93	0.65	000.000	00.000
19.30	010	015	065	00.27	0.00	0000	0000	0.10	0.00	00.00	00.042	21.06	0.79	0.92	0.65	000.000	00.000
20.00	010	014	063	00.25	0.00	0000	0000	0.11	0.00	00.00	00.043	21.08	0.73	0.91	0.66	000.000	00.000

TABLE 41: Polypropylene - 2 m corridor - 40 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	010	016	030	00.00	00.0	0000	0000	0.07	0.00	00.00	00.115	19.31	0.00	0.00	0.00	000.000	00.000
00.30	011	017	036	00.00	00.5	0000	0000	0.07	0.00	00.00	00.115	19.31	0.00	0.00	0.00	000.000	00.000
01.00	010	031	054	00.00	00.5	0000	0000	0.07	0.00	00.00	00.116	19.25	0.00	0.00	0.00	000.000	00.000
01.30	010	037	057	00.00	00.6	0000	0000	0.07	0.00	00.05	00.120	19.27	0.00	0.00	0.00	000.000	00.000
02.00	010	041	065	00.00	00.7	0000	0000	0.08	0.00	00.15	00.123	19.37	0.00	0.00	0.00	000.000	00.000
02.30	010	045	077	00.00	00.2	0000	0000	0.08	0.00	00.17	00.125	19.31	0.00	0.00	0.00	000.000	00.000
03.00	009	053	090	00.00	01.1	0000	0000	0.08	0.00	00.23	00.124	19.12	0.00	0.00	0.00	000.000	00.000
03.30	010	060	100	00.39	01.4	0001	0000	0.09	0.00	00.33	00.122	19.10	0.00	0.00	0.00	000.000	00.000
04.00	010	065	110	00.42	02.1	0003	0000	0.08	0.00	00.44	00.122	19.17	0.00	0.00	0.00	000.000	00.000
04.30	010	070	117	00.47	02.3	0004	0000	0.08	0.00	00.51	00.125	18.97	0.00	0.00	0.00	000.000	00.000
05.00	010	072	120	00.47	02.4	0003	0000	0.08	0.00	00.59	00.127	19.03	0.00	0.00	0.00	000.000	00.000
05.30	009	075	127	00.47	02.9	0004	0001	0.08	0.00	00.62	00.124	18.90	0.00	0.00	0.00	000.000	00.000
06.00	010	085	144	00.48	03.1	0005	0004	0.09	0.00	00.61	00.133	18.88	0.00	0.00	0.00	000.000	00.000
06.30	009	095	155	00.52	03.2	0005	0007	0.09	0.00	00.65	00.132	18.91	0.00	0.00	0.00	000.000	00.000
07.00	009	109	177	00.55	02.3	0005	0012	0.09	0.00	00.76	00.146	18.77	0.00	0.00	0.00	000.000	00.000
07.30	009	121	200	00.53	07.7	0015	0018	0.10	0.00	00.90	00.147	18.47	0.00	0.00	0.00	000.000	00.000
08.00	010	146	333	00.57	09.2	0020	0025	0.12	0.00	01.00	00.153	18.75	0.00	0.00	0.00	000.000	00.000
08.30	009	175	437	00.64	09.7	0022	0037	0.23	0.00	01.16	00.139	18.70	0.00	0.00	0.00	000.000	00.000
09.00	010	221	672	00.75	18.9	0062	0044	0.37	0.00	01.34	00.168	18.65	0.00	0.00	0.00	000.000	00.000
09.30	009	230	540	00.74	08.6	0027	0108	0.23	0.00	01.73	00.186	18.14	0.00	0.00	0.00	000.000	00.000
10.00	010	130	340	00.56	03.5	0007	0115	0.16	0.00	02.35	00.224	17.76	0.00	0.00	0.00	000.000	00.000
10.30	010	104	186	00.45	01.3	0003	0116	0.15	0.00	03.59	00.239	14.14	0.00	0.00	0.00	000.000	00.000

TABLE 42: Polypropylene - 2 m corridor - 10 cm opening.

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	014	030	061	00.00	00.0	0000	0000	0.07	0.00	00.00	00.000	20.77	0.00	0.00	0.00	026.703	00.000
00.30	014	063	085	00.50	00.0	0000	0000	0.08	0.00	00.00	00.000	21.22	0.00	0.00	0.00	026.540	00.000
01.00	014	056	080	00.45	00.0	0000	0000	0.09	0.00	00.00	00.000	21.08	0.00	0.00	0.00	026.592	00.000
01.30	014	055	081	00.43	00.0	0000	0000	0.08	0.00	00.36	00.000	20.77	0.00	0.00	0.00	026.547	00.000
02.00	014	060	086	00.47	00.0	0000	0000	0.08	0.00	00.22	00.000	20.17	0.00	0.00	0.00	026.544	00.000
02.30	014	068	094	00.54	00.0	0000	0000	0.08	0.00	00.32	00.000	20.22	0.00	0.00	0.00	026.514	00.000
03.00	014	078	103	00.53	00.0	0000	0000	0.09	0.00	00.46	00.000	20.24	0.00	0.00	0.00	026.512	00.000
03.30	014	091	115	00.56	00.8	0001	0000	0.08	0.00	00.64	00.153	19.98	0.00	0.00	0.00	026.505	00.000
04.00	014	105	127	00.63	01.6	0002	0000	0.09	0.00	00.38	00.157	20.00	0.00	0.00	0.00	026.437	00.000
04.30	014	119	144	00.61	02.3	0003	0000	0.09	0.00	01.10	00.166	19.53	0.00	0.00	0.00	026.455	00.000
05.00	014	133	161	00.63	01.5	0002	0002	0.18	0.00	01.39	00.171	19.71	0.00	0.00	0.00	026.432	00.000
05.30	014	152	190	00.69	06.8	0014	0007	0.27	0.00	01.54	00.177	19.35	0.00	0.00	0.00	026.457	00.000
06.00	014	187	289	00.81	37.3	0074	0026	0.36	0.00	01.85	00.178	18.38	0.00	0.00	0.00	026.474	00.000
06.30	014	225	331	00.84	28.5	0063	0077	0.46	0.00	03.05	00.199	18.51	0.00	0.00	0.00	026.379	00.000
07.00	014	175	669	00.67	44.4	0007	0065	0.37	0.00	06.02	00.222	16.93	0.00	0.00	0.00	026.351	00.000
07.30	014	135	567	00.54	01.1	0002	0087	0.20	0.00	01.49	00.243	13.15	0.00	0.00	0.00	026.333	00.000

TIME	TEMP1 °C	TEMP2 °C	TEMP3 °C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	015	020	038	00.00	00.0	0000	0000	0.07	0.00	00.00	00.000	21.17	0.00	0.00	0.00	000.000	00.000
00.30	015	064	075	00.52	00.0	0000	0000	0.07	0.00	00.00	00.000	20.82	0.00	0.00	0.00	000.000	00.000
01.00	015	056	066	00.47	00.0	0000	0000	0.07	0.00	00.53	00.000	20.75	0.00	0.00	0.00	000.000	00.000
01.30	015	055	067	00.46	00.0	0000	0000	0.08	0.00	00.48	00.000	20.12	0.00	0.00	0.00	000.000	00.000
02.00	015	063	075	00.53	00.0	0000	0000	0.08	0.00	00.75	00.000	20.10	0.00	0.00	0.00	000.000	00.000
02.30	015	072	085	00.56	00.0	0000	0000	0.09	0.00	00.46	00.149	20.26	0.00	0.00	0.00	000.000	00.000
03.00	015	083	094	00.54	00.0	0000	0000	0.09	0.00	00.59	00.145	20.31	0.00	0.00	0.00	000.000	00.000
03.30	015	097	109	00.63	00.2	0000	0000	0.06	0.00	00.75	00.151	20.15	0.00	0.00	0.00	000.000	00.000
04.00	015	111	126	00.64	01.9	0002	0000	0.09	0.00	00.98	00.155	19.65	0.00	0.00	0.00	000.000	00.000
04.30	015	132	148	00.59	03.8	0006	0001	0.09	0.00	01.19	00.158	19.48	0.00	0.00	0.00	000.000	00.000
05.00	015	155	136	00.70	07.7	0012	0005	0.12	0.00	01.44	00.153	19.10	0.00	0.00	0.00	000.000	00.000
05.30	015	189	731	00.77	12.8	0025	0014	0.22	0.00	01.72	00.166	17.87	0.00	0.00	0.00	000.000	00.000
06.00	015	241	811	00.90	65.5	0161	0089	0.48	0.00	02.81	00.169	18.42	0.00	0.00	0.00	000.000	00.000
06.30	015	182	772	00.68	01.1	0002	0100	0.14	0.00	06.32	00.313	16.24	0.00	0.00	0.00	000.000	00.000
07.00	015	139	370	00.61	00.0	0000	0100	0.49	0.00	02.40	00.235	13.27	0.00	0.00	0.00	000.000	00.000

TABLE 41: Polypropylene - 2 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT kg	WT.LOSS Kg/MIN
00.00	010	016	030	00.00	00.0	0000	0000	0.07	0.00	00.00	00.115	19.31	0.00	0.00	0.00	000.000	00.000
00.30	011	017	046	00.00	00.6	0000	0000	0.07	0.00	00.00	00.115	19.21	0.00	0.00	0.00	000.000	00.000
01.00	010	031	054	00.00	00.5	0000	0000	0.07	0.00	00.00	00.116	19.29	0.00	0.00	0.00	000.000	00.000
01.30	010	037	057	00.00	00.6	0000	0000	0.07	0.00	00.13	00.120	19.27	0.00	0.00	0.00	000.000	00.000
02.00	010	041	065	00.00	00.7	0000	0000	0.06	0.00	00.15	00.123	19.37	0.00	0.00	0.00	000.000	00.000
02.30	010	045	077	00.00	00.2	0000	0000	0.08	0.00	00.17	00.125	19.21	0.00	0.00	0.00	000.000	00.000
03.00	009	053	090	00.00	01.1	0000	0000	0.08	0.00	00.23	00.124	19.12	0.00	0.00	0.00	000.000	00.000
03.30	010	064	100	00.36	01.4	0001	0000	0.08	0.00	00.32	00.123	19.16	0.00	0.00	0.00	000.000	00.000
04.00	010	065	110	00.42	02.1	0003	0000	0.08	0.00	00.44	00.122	19.17	0.00	0.00	0.00	000.000	00.000
04.30	010	070	117	00.47	02.5	0004	0000	0.08	0.00	00.51	00.125	18.97	0.00	0.00	0.00	000.000	00.000
05.00	010	072	120	00.47	02.4	0003	0000	0.08	0.00	00.59	00.127	19.03	0.00	0.00	0.00	000.000	00.000
05.30	009	075	127	00.47	02.9	0004	0001	0.08	0.00	00.62	00.130	18.90	0.00	0.00	0.00	000.000	00.000
06.00	010	085	144	00.48	03.1	0005	0004	0.09	0.00	00.61	00.133	18.88	0.00	0.00	0.00	000.000	00.000
06.30	009	095	155	00.52	03.2	0005	0007	0.09	0.00	00.65	00.132	18.71	0.00	0.00	0.00	000.000	00.000
07.00	009	109	177	00.55	02.2	0005	0012	0.09	0.00	00.76	00.146	18.77	0.00	0.00	0.00	000.000	00.000
07.30	009	121	200	00.56	07.7	0015	0018	0.10	0.00	00.39	00.147	18.47	0.00	0.00	0.00	000.000	00.000
08.00	010	146	333	00.57	09.2	0020	0025	0.12	0.00	01.00	00.153	18.75	0.00	0.00	0.00	000.000	00.000
08.30	009	175	437	00.54	08.7	0022	0037	0.23	0.00	01.16	00.157	18.74	0.00	0.00	0.00	000.000	00.000
09.00	010	221	672	00.73	18.9	0062	0064	0.37	0.00	01.34	00.168	18.66	0.00	0.00	0.00	000.000	00.000
09.30	009	230	540	00.74	08.6	0027	0100	0.23	0.00	01.73	00.186	18.14	0.00	0.00	0.00	000.000	00.000
10.00	010	130	340	00.56	03.5	0007	0115	0.16	0.00	02.35	00.224	17.76	0.00	0.00	0.00	000.000	00.000
10.30	010	104	186	00.45	01.3	0003	0116	0.15	0.00	03.79	00.239	14.14	0.00	0.00	0.00	000.000	00.000

TABLE 42: Polypropylene - 2 m corridor - 10 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	030	061	00.00	00.0	0000	0000	0.07	0.00	00.00	00.000	20.79	0.00	0.00	0.00	026.793	00.000
00.30	014	053	086	00.59	00.0	0000	0000	0.08	0.00	00.00	00.000	21.22	0.00	0.00	0.00	026.540	00.000
01.00	014	055	080	00.45	00.0	0000	0000	0.09	0.00	00.00	00.000	21.08	0.00	0.00	0.00	026.592	00.000
01.30	014	055	081	00.43	00.0	0000	0000	0.08	0.00	00.36	00.000	20.79	0.00	0.00	0.00	026.547	00.000
02.00	014	064	086	00.47	00.0	0000	0000	0.08	0.00	00.22	00.000	20.17	0.00	0.00	0.00	026.544	00.000
02.30	014	069	094	00.54	00.0	0000	0000	0.08	0.00	00.32	00.000	20.22	0.00	0.00	0.00	026.514	00.000
03.00	014	078	103	00.53	00.0	0000	0000	0.09	0.00	00.46	00.000	20.24	0.00	0.00	0.00	026.512	00.000
03.30	014	091	115	00.56	00.8	0001	0000	0.08	0.00	00.64	00.153	19.59	0.00	0.00	0.00	026.495	00.000
04.00	014	105	127	00.63	01.6	0002	0000	0.09	0.00	00.88	00.157	20.00	0.00	0.00	0.00	026.437	00.000
04.30	014	119	144	00.61	02.3	0003	0000	0.09	0.00	01.10	00.166	19.55	0.00	0.00	0.00	026.455	00.000
05.00	014	133	161	00.63	01.6	0002	0002	0.18	0.00	01.29	00.171	19.31	0.00	0.00	0.00	026.432	00.000
05.30	014	152	190	00.69	06.8	0014	0007	0.27	0.00	01.54	00.173	19.35	0.00	0.00	0.00	026.457	00.000
06.00	014	187	289	00.81	37.3	0074	0026	0.36	0.00	01.85	00.178	18.90	0.00	0.00	0.00	026.434	00.000
06.30	014	225	331	00.84	28.5	0063	0077	0.46	0.00	03.05	00.199	18.51	0.00	0.00	0.00	026.379	00.000
07.00	014	175	569	00.69	04.4	0007	0065	0.37	0.00	05.02	00.355	15.83	0.00	0.00	0.00	026.351	00.000
07.30	014	135	567	00.64	01.1	0002	0087	0.20	0.00	01.49	00.243	13.15	0.00	0.00	0.00	026.383	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	015	029	038	00.00	00.0	0000	0000	0.07	0.00	00.00	00.000	21.17	0.00	0.00	0.00	000.000	00.000
00.30	015	064	075	00.52	00.0	0000	0000	0.07	0.00	00.00	00.000	20.82	0.00	0.00	0.00	000.000	00.000
01.00	015	056	066	00.47	00.0	0000	0000	0.07	0.00	00.53	00.000	20.75	0.00	0.00	0.00	000.000	00.000
01.30	015	055	067	00.46	00.0	0000	0000	0.08	0.00	00.48	00.000	20.12	0.00	0.00	0.00	000.000	00.000
02.00	015	063	073	00.53	00.0	0000	0000	0.06	0.00	00.73	00.000	20.10	0.00	0.00	0.00	000.000	00.000
02.30	015	072	085	00.56	00.0	0000	0000	0.09	0.00	00.46	00.149	20.26	0.00	0.00	0.00	000.000	00.000
03.00	015	083	094	00.54	00.0	0000	0000	0.08	0.00	00.59	00.145	20.31	0.00	0.00	0.00	000.000	00.000
03.30	015	097	109	00.65	00.2	0000	0000	0.08	0.00	00.76	00.151	20.15	0.00	0.00	0.00	000.000	00.000
04.00	015	111	126	00.64	01.9	0002	0000	0.08	0.00	00.98	00.155	19.65	0.00	0.00	0.00	000.000	00.000
04.30	015	132	149	00.69	03.3	0004	0001	0.09	0.00	01.19	00.158	19.48	0.00	0.00	0.00	000.000	00.000
05.00	015	156	186	00.70	07.7	0012	0005	0.12	0.00	01.44	00.153	19.10	0.00	0.00	0.00	000.000	00.000
05.30	015	189	731	00.79	12.8	0025	0014	0.22	0.00	01.72	00.166	17.87	0.00	0.00	0.00	000.000	00.000
06.00	015	241	811	00.90	65.5	0161	0089	0.48	0.00	02.81	00.180	18.42	0.00	0.00	0.00	000.000	00.000
06.30	015	182	772	00.68	01.1	0002	0100	0.10	0.00	06.02	00.910	16.24	0.00	0.00	0.00	000.000	00.000
07.00	015	139	370	00.61	00.0	0000	0100	0.09	0.00	02.40	00.235	13.27	0.00	0.00	0.00	000.000	00.000

TABLE 42: Polypropylene - 2 m corridor - 10 cm opening (continued).

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	014	023	051	00.26	0.00	0000	0000	0.09	0.00	00.00	00.000	20.67	0.00	0.00	0.00	000.000	00.000
00.30	014	044	110	00.39	0.00	0000	0000	0.09	0.00	00.13	00.000	20.66	0.00	0.00	0.00	000.000	00.000
01.00	014	046	127	00.37	0.00	0000	0000	0.09	0.00	00.19	00.000	20.26	0.00	0.00	0.00	000.000	00.000
01.30	014	048	129	00.44	0.00	0000	0000	0.09	0.00	00.27	00.000	20.19	0.00	0.00	0.00	000.000	00.000
02.00	014	052	139	00.43	0.00	0000	0000	0.09	0.00	00.29	00.000	20.09	0.00	0.00	0.00	000.000	00.000
02.30	014	058	155	00.44	0.00	0000	0000	0.09	0.00	00.36	00.000	20.07	0.01	0.00	0.00	000.000	00.000
03.00	014	065	174	00.45	0.00	0000	0000	0.09	0.00	00.43	00.000	19.95	0.01	0.00	0.00	000.000	00.000
03.30	014	068	189	00.45	0.00	0000	0000	0.09	0.00	00.48	00.000	19.34	0.01	0.00	0.01	000.000	00.000
04.00	014	081	224	00.47	0.00	0000	0000	0.10	0.00	00.53	00.000	19.73	0.02	0.01	0.01	000.000	00.000
04.30	014	099	265	00.47	0.00	0000	0000	0.10	0.00	00.78	00.404	19.53	0.02	0.01	0.01	000.000	00.000
05.00	014	112	393	00.51	0.00	0000	0000	0.10	0.00	00.94	00.400	19.37	0.04	0.02	0.02	000.000	00.000
05.30	014	134	343	00.49	0.00	0000	0000	0.10	0.00	01.13	00.401	19.17	0.07	0.03	0.03	000.000	00.000
06.00	014	144	359	00.54	0.00	0000	0000	0.11	0.00	01.28	00.397	18.97	0.07	0.04	0.05	000.000	00.000
06.30	014	162	326	00.56	0.00	0000	0000	0.11	0.00	01.48	00.383	18.73	0.10	0.05	0.07	000.000	00.000
07.00	014	190	413	00.53	0.00	0000	0000	0.12	0.00	01.71	00.333	18.54	0.12	0.06	0.10	000.000	00.000
07.30	014	223	729	00.61	0.00	0000	0000	0.16	0.00	02.53	00.324	16.46	0.24	0.15	0.16	000.000	00.000
08.00	014	282	722	00.72	0.00	0000	0000	0.27	0.00	05.41	00.814	16.26	0.48	0.34	0.48	000.000	00.000
08.30	014	197	322	00.57	0.00	0000	0000	0.50	0.00	03.49	00.814	11.95	1.95	1.21	2.13	000.000	00.000
09.00	014	153	329	00.53	0.00	0000	0000	0.35	0.00	00.43	00.392	17.98	1.30	1.48	1.58	000.000	00.000
09.30	014	139	267	00.49	0.00	0000	0000	0.32	0.00	00.09	00.339	20.41	1.20	1.29	1.34	000.000	00.000
10.00	014	118	233	00.47	0.00	0000	0000	0.29	0.00	00.00	00.292	20.51	1.21	1.16	1.23	000.000	00.000
10.30	014	106	212	00.51	0.00	0000	0000	0.28	0.00	00.00	00.234	20.66	1.03	1.23	1.33	000.000	00.000
11.00	014	101	194	00.50	0.00	0000	0000	0.26	0.00	00.00	00.272	20.74	1.15	1.23	1.36	000.000	00.000
11.30	014	092	178	00.45	0.00	0000	0000	0.24	0.00	00.00	00.265	20.77	1.14	1.26	1.33	000.000	00.000
12.00	014	085	166	00.45	0.00	0000	0000	0.22	0.00	00.00	00.261	20.78	1.07	1.26	1.22	000.000	00.000
12.30	014	086	155	00.38	0.00	0000	0000	0.20	0.00	00.00	00.257	20.79	1.10	1.23	1.29	000.000	00.000
13.00	014	078	147	00.40	0.00	0000	0000	0.20	0.00	00.00	00.261	20.79	1.03	1.22	1.25	000.000	00.000
13.30	014	074	139	00.41	0.00	0000	0000	0.19	0.00	00.00	00.254	20.80	1.00	1.22	1.24	000.000	00.000
14.00	014	072	132	00.41	0.00	0000	0000	0.18	0.00	00.00	00.252	20.82	0.95	1.20	1.26	000.000	00.000
14.30	014	069	126	00.37	0.00	0000	0000	0.17	0.00	00.00	00.248	20.81	0.91	1.13	1.16	000.000	00.000
15.00	014	065	121	00.39	0.00	0000	0000	0.16	0.00	00.00	00.237	20.82	0.96	1.14	1.18	000.000	00.000
15.30	014	063	117	00.36	0.00	0000	0000	0.16	0.00	00.00	00.227	20.82	0.89	1.13	1.07	000.000	00.000
16.00	014	061	113	00.37	0.00	0000	0000	0.16	0.00	00.00	00.229	20.83	0.86	1.12	1.04	000.000	00.000
16.30	014	059	109	00.37	0.00	0000	0000	0.16	0.00	00.00	00.228	20.83	0.90	1.05	0.97	000.000	00.000
17.00	014	058	106	00.37	0.00	0000	0000	0.15	0.00	00.00	00.225	20.83	0.81	1.07	0.95	000.000	00.000
17.30	014	056	103	00.37	0.00	0000	0000	0.15	0.00	00.00	00.220	20.83	0.88	1.05	0.94	000.000	00.000
18.00	014	054	100	00.36	0.00	0000	0000	0.14	0.00	00.00	00.225	20.84	0.89	1.06	0.93	000.000	00.000
18.30	014	055	097	00.39	0.00	0000	0000	0.15	0.00	00.00	00.222	20.84	0.83	1.05	0.94	000.000	00.000
19.00	014	051	095	00.38	0.00	0000	0000	0.13	0.00	00.00	00.223	20.84	0.88	1.04	0.94	000.000	00.000
19.30	014	049	092	00.33	0.00	0000	0000	0.13	0.00	00.00	00.222	20.84	0.87	1.03	0.94	000.000	00.000
20.00	014	049	090	00.37	0.00	0000	0000	0.13	0.00	00.00	00.214	20.84	0.89	1.00	0.93	000.000	00.000

TABLE 43: Polypropylene - 4 m corridor - 40 cm opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	015	043	00.00	00.0	0000	0000	0.08	0.00	00.00	00.135	20.73	0.00	0.00	0.00	000.000	00.000
00.30	010	041	093	00.37	00.1	0000	0000	0.12	0.00	00.00	00.132	20.57	0.00	0.00	0.00	000.000	00.000
01.00	010	046	024	00.37	00.0	0000	0000	0.11	0.00	00.00	00.133	20.72	0.00	0.00	0.00	000.000	00.000
01.30	010	046	083	00.41	00.0	0000	0000	0.11	0.00	00.00	00.134	20.34	0.00	0.00	0.00	000.000	00.000
02.00	010	049	069	00.41	00.1	0000	0000	0.12	0.00	00.17	00.137	20.24	0.00	0.00	0.00	000.000	00.000
02.30	010	052	091	00.43	00.0	0000	0000	0.12	0.00	00.17	00.138	20.13	0.00	0.00	0.00	000.000	00.000
03.00	010	055	107	00.52	00.5	0000	0000	0.13	0.00	00.19	00.138	20.24	0.00	0.00	0.00	000.000	00.000
03.30	010	067	139	00.47	03.4	0003	0000	0.16	0.00	00.22	00.136	20.24	0.00	0.00	0.00	000.000	00.000
04.00	010	086	165	00.53	11.1	0012	0003	0.18	0.00	00.24	00.138	20.42	0.00	0.00	0.00	000.000	00.000
04.30	010	109	229	00.65	11.3	0015	0010	0.29	0.00	00.25	00.141	20.13	0.00	0.00	0.00	000.000	00.000
05.00	010	134	311	00.70	13.1	0020	0022	0.36	0.00	00.35	00.141	20.26	0.00	0.00	0.00	000.000	00.000
05.30	010	162	479	00.73	32.0	0095	0047	0.46	0.00	00.54	00.142	17.73	0.00	0.00	0.00	000.000	00.000
06.00	010	161	285	00.81	15.4	0029	0072	0.37	0.00	00.77	00.148	17.42	0.00	0.00	0.00	000.000	00.000
06.30	010	102	292	00.53	03.3	0004	0096	0.20	0.00	01.07	00.154	17.03	0.00	0.00	0.00	000.000	00.000
07.00	010	080	165	00.47	01.7	0002	0097	0.16	0.00	01.56	00.162	16.75	0.00	0.00	0.00	000.000	00.000
07.30	010	069	140	00.42	01.4	0001	0099	0.15	0.00	01.35	00.154	17.54	0.00	0.00	0.00	000.000	00.000
08.00	010	062	124	00.42	01.0	0001	0099	0.13	0.00	00.18	00.144	18.79	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	011	031	061	00.00	00.0	0000	0000	0.10	0.00	00.00	00.132	19.27	0.00	0.00	0.00	000.000	00.000
00.30	011	047	074	00.45	00.0	0000	0000	0.12	0.00	00.00	00.115	18.83	0.00	0.00	0.00	000.000	00.000
01.00	011	042	064	00.47	00.1	0000	0000	0.11	0.00	00.00	00.118	19.34	0.00	0.00	0.00	000.000	00.000
01.30	011	043	070	00.46	00.2	0000	0000	0.11	0.00	00.47	00.122	19.30	0.00	0.00	0.00	000.000	00.000
02.00	011	049	064	00.51	00.2	0000	0000	0.12	0.00	00.00	00.121	18.51	0.00	0.00	0.00	000.000	00.000
02.30	011	051	089	00.51	00.3	0000	0000	0.12	0.00	00.00	00.122	18.79	0.00	0.00	0.00	000.000	00.000
03.00	011	056	102	00.50	00.4	0000	0000	0.13	0.00	00.47	00.122	18.77	0.00	0.00	0.00	000.000	00.000
03.30	011	063	118	00.54	01.5	0001	0000	0.14	0.00	00.12	00.120	18.00	0.00	0.00	0.00	000.000	00.000
04.00	011	067	129	00.64	03.2	0004	0000	0.15	0.00	00.20	00.120	18.47	0.00	0.00	0.00	000.000	00.000
04.30	011	074	152	00.62	05.0	0006	0002	0.16	0.00	00.21	00.12	19.35	0.00	0.00	0.00	000.000	00.000
05.00	010	085	189	00.72	06.1	0009	0007	0.17	0.00	00.37	00.122	18.20	0.00	0.00	0.00	000.000	00.000
05.30	011	103	229	00.80	09.2	0015	0013	0.22	0.00	00.47	00.125	18.14	0.00	0.00	0.00	000.000	00.000
06.00	010	119	274	00.92	17.2	0033	0027	0.29	0.00	00.53	00.123	17.72	0.00	0.00	0.00	000.000	00.000
06.30	010	142	412	01.14	18.4	0047	0050	0.38	0.00	00.30	00.128	17.67	0.00	0.00	0.00	000.000	00.000
07.00	010	157	659	01.19	22.0	0061	0088	0.50	0.00	01.29	00.139	16.97	0.00	0.00	0.00	000.000	00.000
07.30	010	124	567	00.87	07.0	0013	0096	0.30	0.00	01.32	00.153	16.52	0.00	0.00	0.00	000.000	00.000
08.00	010	100	343	00.74	03.2	0004	0101	0.21	0.00	04.34	00.2[illegible]	14.70	0.00	0.00	0.00	000.000	00.000
08.30	011	053	164	00.65	02.1	0003	0103	0.18	0.00	00.54	00.155	14.50	0.00	0.00	0.00	000.000	00.000
09.00	010	073	139	00.61	01.1	0001	0105	0.16	0.00	00.34	00.130	17.23	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.o.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	010	070	036	00.00	00.0	0000	0000	0.08	0.00	00.00	00.077	19.39	0.00	0.00	0.00	000.000	00.000
00.30	010	047	093	00.49	00.0	0000	0000	0.12	0.00	00.00	00.077	18.72	0.00	0.00	0.00	000.000	00.000
01.00	010	052	069	00.53	00.0	0000	0000	0.11	0.00	00.00	00.075	19.09	0.00	0.00	0.00	000.000	00.000
01.30	010	047	080	00.53	00.0	0000	0000	0.11	0.00	00.04	00.075	19.03	0.00	0.00	0.00	000.000	00.000
02.00	010	050	085	00.56	00.0	0000	0000	0.12	0.00	00.25	00.078	19.53	0.00	0.00	0.00	000.000	00.000
02.30	010	054	094	00.58	00.2	0000	0000	0.11	0.00	00.23	00.079	19.42	0.00	0.00	0.00	000.000	00.000
03.00	010	064	116	00.66	01.2	0001	0000	0.11	0.00	00.23	00.079	18.51	0.00	0.00	0.00	000.000	00.000
03.30	010	076	147	00.75	02.4	0003	0001	0.12	0.00	00.26	00.078	18.31	0.00	0.00	0.00	000.000	00.000
04.00	010	091	186	00.77	07.5	0011	0007	0.12	0.00	00.32	00.079	15.48	0.00	0.00	0.00	000.000	00.000
04.30	010	112	237	00.85	14.2	0025	0015	0.13	0.00	00.50	00.085	13.26	0.00	0.00	0.00	000.000	00.000
05.00	010	142	325	01.06	25.7	0061	0036	0.16	0.00	00.67	00.085	17.30	0.00	0.00	0.00	000.000	00.000
05.30	010	167	608	00.76	57.1	0055	0074	0.18	0.00	00.97	00.089	17.00	0.00	0.00	0.00	000.000	00.000
06.00	010	156	251	01.00	19.0	0044	0091	0.29	0.00	01.30	00.095	17.23	0.00	0.00	0.00	000.000	00.000
06.30	010	110	195	00.68	04.0	0006	0093	0.36	0.00	01.38	00.147	16.72	0.00	0.00	0.00	000.000	00.000
07.00	010	069	167	00.58	02.3	0003	0088	0.17	0.00	03.07	00.179	15.26	0.00	0.00	0.00	000.000	00.000
07.30	010	076	133	00.61	01.6	0002	0088	0.15	0.00	00.73	00.113	15.01	0.00	0.00	0.00	000.000	00.000
08.00	010	066	124	00.60	01.0	0001	0088	0.14	0.00	00.22	00.092	17.77	0.00	0.00	0.00	000.000	00.000
08.30	010	061	116	00.49	00.7	0001	0083	0.13	0.00	00.03	00.094	19.46	0.00	0.00	0.00	000.000	00.000

TABLE 44: Polypropylene - 4 m corridor - 10 m opening.

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	012	017	038	00.00	00.0	0000	0000	0.06	0.00	00.00	00.000	21.02	0.00	0.00	0.00	000.000	00.000
00.30	012	051	127	00.00	00.0	0000	0000	0.08	0.00	00.00	00.000	21.02	0.00	0.00	0.00	000.000	00.000
01.00	012	047	091	00.20	00.0	0000	0000	0.08	0.00	00.00	00.000	21.05	0.00	0.00	0.00	000.000	00.000
01.30	012	044	101	00.21	00.1	0000	0000	0.09	0.00	00.44	00.000	20.78	0.00	0.00	0.00	000.000	00.000
02.00	012	050	111	00.17	00.2	0000	0000	0.08	0.00	00.43	00.000	20.21	0.00	0.00	0.00	000.000	00.000
02.30	012	056	129	00.33	00.1	0000	0000	0.09	0.00	00.36	00.000	20.31	0.00	0.00	0.00	000.000	00.000
03.00	012	065	159	00.25	00.0	0000	0000	0.10	0.00	00.46	00.129	20.22	0.00	0.00	0.00	000.000	00.000
03.30	012	076	172	00.29	00.5	0000	0000	0.11	0.00	00.60	00.133	20.00	0.00	0.00	0.00	000.000	00.000
04.00	012	086	197	00.36	01.7	0002	0000	0.11	0.00	00.74	00.123	20.24	0.00	0.00	0.00	000.000	00.000
04.30	012	100	237	00.31	02.6	0003	0000	0.12	0.00	00.87	00.129	19.75	0.00	0.00	0.00	000.000	00.000
05.00	011	123	337	00.43	05.0	0007	0003	0.14	0.00	01.01	00.133	19.93	0.00	0.00	0.00	000.000	00.000
05.30	012	145	425	00.46	09.3	0016	0009	0.15	0.00	01.18	00.135	19.34	0.00	0.00	0.00	000.000	00.000
06.00	011	176	796	00.52	41.8	0085	0027	0.25	0.00	01.54	00.141	19.04	0.00	0.00	0.00	000.000	00.000
06.30	012	187	571	00.57	33.6	0077	0077	0.26	0.00	01.77	00.145	18.57	0.00	0.00	0.00	000.000	00.000
07.00	012	150	351	00.48	11.4	0020	0090	0.18	0.00	02.22	00.149	18.46	0.00	0.00	0.00	000.000	00.000
07.30	013	120	249	00.42	04.1	0006	0096	0.15	0.00	03.86	00.262	17.45	0.00	0.00	0.00	000.000	00.000
08.00	012	104	225	00.36	02.7	0003	0097	0.14	0.00	02.34	00.380	14.93	0.00	0.00	0.00	000.000	00.000

TIME	TEMP1 'C	TEMP2 'C	TEMP3 'C	AIR VEL m.p.s	SMOKE 1 OD/m	RATE m3/MIN	TOTAL m3	RAD 1 W/cm2	RAD 2 W/cm2	CO2 %	CO %	O2 %	SMOKE 2 OD/m	SMOKE 3 OD/m	SMOKE 4 OD/m	WEIGHT Kg	WT.LOSS Kg/MIN
00.00	013	020	043	00.00	00.0	0000	0000	0.00	0.00	00.00	00.000	20.82	0.00	0.00	0.00	000.000	00.000
00.30	012	045	151	00.15	00.0	0000	0000	0.00	0.00	00.00	00.000	21.06	0.00	0.00	0.00	000.000	00.000
01.00	013	052	124	00.26	00.1	0000	0000	0.08	0.00	00.00	00.056	21.26	0.00	0.00	0.00	000.000	00.000
01.30	012	050	135	00.25	00.1	0000	0000	0.07	0.00	00.41	00.060	20.85	0.00	0.00	0.00	000.000	00.000
02.00	012	056	145	00.32	00.3	0000	0000	0.08	0.00	00.49	00.062	20.60	0.00	0.00	0.00	000.000	00.000
02.30	012	061	160	00.31	00.3	0000	0000	0.08	0.00	00.48	00.060	20.49	0.00	0.00	0.00	000.000	00.000
03.00	012	068	184	00.37	01.1	0001	0000	0.10	0.00	00.58	00.057	20.19	0.00	0.00	0.00	000.000	00.000
03.30	012	078	220	00.34	03.1	0003	0000	0.12	0.00	00.67	00.058	20.12	0.00	0.00	0.00	000.000	00.000
04.00	012	094	255	00.40	03.2	0004	0000	0.12	0.00	00.77	00.053	20.18	0.00	0.00	0.00	000.000	00.000
04.30	012	109	302	00.39	04.7	0006	0003	0.16	0.00	00.95	00.060	19.83	0.00	0.00	0.00	000.000	00.000
05.00	012	127	349	00.49	08.2	0014	0009	0.19	0.00	01.19	00.062	19.50	0.00	0.00	0.00	000.000	00.000
05.30	012	143	411	00.50	10.7	0019	0018	0.20	0.00	01.37	00.066	19.17	0.00	0.00	0.00	000.000	00.000
06.00	012	167	636	00.58	17.9	0040	0035	0.26	0.00	01.67	00.068	18.99	0.00	0.00	0.00	000.000	00.000
06.30	012	188	605	00.65	12.2	0032	0086	0.33	0.00	01.93	00.074	18.62	0.00	0.00	0.00	000.000	00.000
07.00	012	159	372	00.45	06.4	0014	0095	0.19	0.00	02.72	00.081	18.23	0.00	0.00	0.00	000.000	00.000
07.30	012	130	307	00.43	05.5	0008	0101	0.15	0.00	05.54	00.225	16.88	0.00	0.00	0.00	000.000	00.000
08.00	012	114	274	00.42	01.5	0002	0102	0.14	0.00	01.14	00.129	15.39	0.00	0.00	0.00	000.000	00.000
08.30	013	100	244	00.36	02.2	0003	0102	0.13	0.00	00.50	00.084	19.07	0.00	0.00	0.00	000.000	00.000
09.00	012	091	219	00.35	01.4	0002	0102	0.12	0.00	00.23	00.073	20.15	0.00	0.00	0.00	000.000	00.000
09.30	012	085	201	00.34	01.1	0001	0102	0.12	0.00	00.05	00.068	20.39	0.00	0.00	0.00	000.000	00.000

APPENDIX III

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Smoke Production in Fires - 1

Small Scale Experiments

ABSTRACT: The quantity of smoke released in a compartment fire depends both on the nature of the combustible materials involved and on the conditions of burning. The final yield of "cold" smoke is much greater than the quantity predicted from dynamic measurements of hot combustion products issuing from a test rig and is likely to be considerably more than the amount predicted from the results of small scale tests such as ASTM E662 (American Society).

KEYWORDS: compartment fires, smoke production, smoke testing.

By far the major proportion of fatalities in fires are attributable to inhalation of smoke and toxic gases. An obvious solution to this problem would be to find a means of controlling the use of materials which will contribute significantly to smoke production in a fire. In an effort to achieve this, a number of tests have been developed for assessing the smoke production potential of combustible materials. All of these involve burning the material under a set of precisely defined conditions which are intended to be representative of a typical fire. With a few exceptions, the results are expressed in terms of the optical density of the smoke collected in a known volume and may be used to place in order different materials according to their propensity to produce smoke.

The most widely used test is ASTM E662 (American Society), often referred to as the "NBS Test". While many variants have been proposed (e.g. Seader and Chien, 1974; Routley and Skippen, 1980; Edgerley and Pettett, 1980) both in the apparatus itself and in the procedure, the basic method remains the same. A small sample of material in a vertical configuration is exposed to a radiant heat flux in the presence or absence of flame, and the opacity of the smoke produced is measured as it is collected in a known volume (0.51 m^3). The smoke yield can be expressed either in terms of the surface area exposed to the radiant heat flux (American Society) or in terms of the mass loss during the test (Seader and Chein, 1974; Edgerley and Pettett, 1980). In adopting such a test, it is tacitly assumed that smoke yield is a property of the material burning and that the conditions of burning are of secondary importance. This is known to be incorrect. For example, a change in the radiant heat flux may not only change the amount of smoke produced, but it may alter the ranking order of a series of combustible materials (Edgerley and Pettett, 1980; Calcraft and Green, 1975).

Attempts have been made to establish whether or not the small scale test results are relevant to real fire situations but these have been of limited success (Christian and Waterman, 1971; Woolley and Murrell, 1979/1980). One of the difficulties that exists is that to measure smoke production in a full scale fire, the volume of smoke is too great to be collected: instead, the optical density is monitored continuously as the smoke flows from the test rig (e.g. at the end of the corridor of a room-corridor assembly (Woolley and Murrell, 1979/1980). The total amount of smoke generated is then obtained by integrating over the duration of the test. Smoke measured in this way can be several hundred degrees higher than the smoke which accumulates in the NBS chamber. The consequences of this have not been investigated systematically.

If a fire occurs within a building, the smoke which invades escape routes is relatively cool and hinders escape by reducing visibility. Other products of combustion may exacerbate the situation by causing irritation of the eyes and respiratory tract, impeding movement still further, but these effects are difficult to quantify. Taking reduced visibility as the primary hazard, it would seem that the yield of "cold smoke" is more relevant to the problem of life safety. For this reason it may be argued that tests involving "static" measurements (e.g. ASTM E662) should be used for materials selection, although the question of whether the results from such small scale tests are relevant to the full-scale fire situation remains to be answered.

A series of experiments involving a ninth-scale room-corridor assembly has been undertaken to investigate these and other features of smoke production. One of the main objectives was to compare smoke yields determined by the dynamic (or flow) method directly with those from static measurements. The programme was designed also to study any effects arising from restricted ventilation and "corridor length", as there are good reasons to suspect that the fire scenario has a significant influence on the final amount of smoke. Such effects may be detected quickly and relatively cheaply on the small scale. Preliminary results and data analysis are presented below.

Smoke measurement

In this paper, smoke yield is expressed in terms of its obscuration potential per gram of material burnt, i.e. as the smoke potential, D_0 with units ob.m^3/g. The unit "obscura" (ob) was introduced by Rasbash and Phillips (1978) and refers to an optical density of 1 db/m. The choice of using decibels (db) rather that bels (b) was for convenience: 1 db/m (i.e. 1 ob) corresponds to a visibility of about 10 m (Rasbash 1967). The smoke potential of a material is obtained by burning a known quantity in a chamber of volume V and measuring the optical density of the accumulated smoke ($D=10 \log (I_0/I)$) by monitoring the attenuation of a light beam of length L passing vertically through the smoke. I and I_0 refer to the intensities of light falling on the photocell in the presence and absence of smoke respectively. Thus

$$D_0 = \frac{10V}{WL} \log \frac{I_0}{I} \qquad \dots (1)$$

where W is the mass of material volatilised and is taken as the difference in the weight of the sample before and after the test (Seader *et al.*, 1974; Rasbash *et al.*, 1978; Rasbash *et al.*, 1979/1980). This will be referred to as D_0(static).

In the small room-corridor tests, the quantity of smoke is determined using the "dynamic" method described above (see Figure 3.16). The total volume of smoke (V_s) is calculated from (Woolley *et al.*, 1979/1980):

$$V_s = \int D_\ell \cdot \dot{V}_f . dt \quad ob.m^3 \qquad \dots (2)$$

where D_ℓ is the instantaneous value of the optical density per metre of the smoke as it discharges from the test rig, i.e.

$$D_\ell = \frac{10}{\ell} \log \; I_0 \qquad \dots (3)$$

where ℓ is the effective pathlength through the smoke which is taken to be the depth of the smoke layer at the end of the corridor. $\dot{V}_f$ is the volumetric rate of discharge of the fire gases from the corridor:

this is calculated from the rate of air inflow to the fire (V_{air}) and the temperature ratio T_3/T_1, where T_3 is the temperature at the end of the corridor and T_1 refers to the ambient (Figure 3.14). Thus:

$$V_f = V_{air} \frac{T_3}{T_1} \qquad \ldots (4)$$

Equation (2) gives the total amount of smoke in terms of the volume which has an optical density 1 ob. The equivalent "standard optical density" (D_0(dynamic)) is then obtained from

$$D_0(\text{dynamic}) = \frac{V_S}{W}\ \text{ob.m}^3/\text{g} \qquad \ldots (5)$$

where W is defined above. Some of the experiments that have been carried out provide an opportunity of comparing D_0(static) and D_0(dynamic) directly.

<u>Apparatus</u>

The small scale "room-corridor assembly" is shown in Figure 3.14. It was designed to enable the fire box (the "room" or compartment") to be weighed continuously while the flows of air and combustion products entered and left through a square duct (the "corridor"). The assembly was constructed from angle iron with panels of Supalux, lined with a ceramic fibreboard (Kaoboard). The cubical fire box had external and internal dimensions of 0.5 m and 0.4 m respectively: one side was open and could be fitted with Kaoboard panels to reduce the opening from 0.4 m down to 0.1 m, as shown in Figure 3.15. The box rested on a wooden platform, 0.5 x 0.5 m, which in turn was supported on five vertical posts (40 mm high and 12 mm diameter rods) fixed to a lower platform (A) which rested directly on two 25 kg load cells. A third platform (B) lying between the latter pair, had holes drilled to allow independent movement of the fire box/load cell assembly (Figure 3.14). This platform had supports resting on the ground and in turn supported an outer box which enclosed the fire compartment on four sides. The end of the "corridor" fitted snugly inside the opening of the outer box with which it was sealed by packing the gap with mineral wool. In this way the "room" and the "corridor" were almost continuous yet the corridor did not interfere with the weight loss measurements. The loss of combustion products into the space between the fire box and the outer enclosure was assumed to be negligible, although there was no way of quantifying this. A deposit of soot accumulated on top of the box during a series of tests.

The corridor, which had a cross section of 0.5 m x 0.5 m, was divided into a lower and upper section, the latter being lined with Kaoboard, giving inner dimensions of 0.4 m wide by 0.2 m high. This arrangement separated the flows and prevented mixing which could stimulate flaming in the corridor under conditions of poor ventilation (e.g. one-quarter opening, Figure 3.15). The air inflow to the fire was determined by means of a vane anemometer located within a circular duct attached to the end of the lower section of the corridor, as illustrated in Figure 3.16. This was effectively the only means by which air could enter the fire box as the other openings were sealed. The area through which air could enter around the supporting posts was negligible. The corridor was made in two sections, each 1 m long, and rested on an angle iron frame whose height enabled the height of the fire box to be matched. A 2 m extension to the upper part of the corridor was constructed to enable the effect of corridor length on D_0(dynamic) to be examined in more detail.

Temperatures were measured at the anemometer (T_1), under the ceiling of the fire box (T_3) and at the end of the corridor, in the outflowing gases (T_2). A small stream of combustion products was withdrawn continuously from the end of the corridor through a 6 mm diameter sampling line, incorporating a filter and drying tube, by means of a diaphragm pump, capacity 6_{ℓ}/min. The CO, CO_2 and O_2 content of the outflow from the pump was monitored continuously using commercial analysis units. The opacity of the smoke flowing from the end of the corridor was determined by a diagonal light beam/photo cell arrangement similar to that used by Woolley *et al.* (1979/1980). Lateral spread of the plume was restricted by two Supalux boards placed so as to maintain the plume width at the height at which the measurement was being made. The depth of the smoke layer was established first by observation and then by limiting the opening roughly to this depth with a single thickness of "clingwrap" (thin polythene sheet used to wrap food). This material softens and sags at temperatures between 100-150°C and will increase the depth of the opening when and as necessary. The depth can be measured at the end of each test.

Most of the experiments described in this paper were carried out at the Scottish Fire Service Training School at Gullane, East Lothian. The test rig was located in the Fire House, a chamber 3 m high and total volume 240 m^3, which could be sealed and used to collect the smoke produced during an experiment. In the early tests, only static measurements were made, with four vertical optical beams located near the corners of the chamber to enable an average smoke density to be calculated and any effect of ambient wind conditions on the uniformity of smoke distribution to be assessed (Figure 3.13). A limited number of tests were carried out with one diagonal and three vertical beams so that measurements of D_0(static) and D_0(dynamic) could be made at the same time. Latterly, dynamic measurements only were made in the Fire Safety Engineering Laboratory with effective corridor lengths of up to 4 m.

Up to thirteen sets of measurements were made (Table 3.1) at 5-second intervals, using a data acquisition system supplied by Datron Ltd, based on that developed for the Fire Research Station. The software was modified to suit the requirements of this project.

Three materials were chosen for this investigation, viz. wood (*Pinus sylvestris*), polymethylmethacrylate (PMMA) and polypropylene (PP). Most of these preliminary experiments were carried out with wood cribs of three sizes, the dimensions of which are given in Table . Moisture content was maintained between 10 per cent and 12 per cent. The plastic fuel beds were prepared as cribs but burned for most of the time as liquid pools contained in a light metal tray 0.22 m square. The original intention was to burn all five fuel beds under the following conditions:

(i) Free burning, no enclosure;

(ii) Full and one-quarter ventilation, no corridor;

(iii) Full and one-quarter ventilation, 1 m corridor; and

(iv) Full and one-quarter ventilation, 2 m corridor.

each test being carried out at least twice. However, a full set of data has not been obtained for all five fuel beds, but some one-half and three-quarters ventilation experiments were carried out, as well as some with a 4 m corridor.

In addition to the small scale room-corridor experiments, the smoke production potential of the materials used in this investigation was determined by the NBS smoke chamber method (American Society) and the test developed at Edinburgh, in which the smoke is collected in a volume of 13.75 m^3 (Rasbash *et al*., 1978; Rasbash *et al*., 1979/80).

Results

The results are presented in terms of standard optical densities, as calculated from Equations 1 and 5, in Table 4.26, Figures 5.14 and 5.16. The values quoted for D_0 (static) refer to the maximum obscuration achieved during the test, in accord with the practice adopted in ASTM E662 (American Society). The subsequent decrease in obscuration merits further study on this scale.

Free burning: It was found that with cribs and PMMA the values calculated for D_0(static) were within about a factor of 2 of D_0 as obtained in the Edinburgh University smoke chamber (Table 4.2). Polypropylene behaved quite differently, giving $D_0 \sim 3.4$ ob m^3/g, compared with 0.35 ob m^3/g from the laboratory test (see Tables 4.1 and 4.2).

Crib fires within the fire box (no corridor): With the small cribs ($\sim$0.5 kg), there was a clear trend towards increasing smoke yield as the ventilation was reduced from 40 cm to 10 cm (Figure 5.14a). However, the yield of smoke from the large cribs was approximately the same for the 40 cm and 10 cm openings, while a significantly greater amount was detected for the 20 cm opening (Figure 5.14c). (The medium cribs appear to behave as the small cribs, but insufficient data are available to confirm this with any confidence [Figure 5.14b]).

Crib fires within the fire box (with corridor): Dynamic smoke measurements could not be made in those experiments in which flame emerged from the end of the corridor: these are indicated in Table 4.26.

No significant trends were observed which could be attributed unambiguously to the effect of corridor length. In this respect (see 'Discussion') only the data from the small cribs should be inspected. The variation of D_0(static) and D_0(dynamic) with corridor length may not be significant, although clearly the two types of measurements give considerably different values of D_0.

With the large cribs, there is a definite increase in D_0(static) with a 1 m corridor, but the 2 m corridor provided no significant change for one-quarter and full ventilation: however, the yield from one-half ventilation rose monotonically.

Plastics in the fire box: The plastics PMMA and PP burned as liquid pool fires. The yield of smoke from PMMA at one-quarter ventilation was a factor of three greater than that from free burning, but the presence of the corridor was found to have only a small effect ($\sim$30 per cent reduction for 2 m). On the other hand, the increase in smoke from PP with one-quarter ventilation was only 15 per cent over that from free burning, and a two metre corridor increased this by a further 25 per cent, giving a value of D_0(static) $\sim$15 times greater than that measured in the EU Smoke Chamber test.

As with wood crib fires, D_0(dynamic) was found to be very much less than D_0(static) for both PMMA and PP. However, while trends are apparent in Figure 5.16 which suggest an increase in D_0(static) with corridor length, these cannot be regarded as significant.

Discussion

The reproducibility of the data obtained in these experiments was reasonable considering that even under the strictly controlled conditions of the NBS test it is difficult to improve the precision to better than ∿25 per cent. Insufficient data have yet been gathered to make a meaningful statistical analysis, but one or two general observations may be made which indicate trends in behaviour. Thus the results indicate that the static smoke yields from small cribs (0.5 kg) burning within the fire box with different ventilation openings are in accord with conventional thinking, i.e. decreased ventilation gives rise to more smoke. The results with the large cribs appear to contradict this, particularly in that one-quarter and full ventilation give the same D_0(static) when there is no corridor. This can be explained in qualitative terms. The fire plume issuing from the 10 cm opening is seen to be very strong, giving a highly turbulent flame in which the efficiency of combustion is likely to increase as a result of greater air entrainment. This will act as an "afterburner" and less smoke will be released as a result. The same argument can be applied to the results (S1 and S$\frac{1}{4}$) obtained with the corridor (1 and 2 m) in place (Figure 5.14c): flames issued from the end of the corridor for both ventilation states, but those from quarter ventilation were much more vigorous. Comment on S$\frac{1}{2}$ is reserved until more data are available.

The presence of a corridor does not appear to make any significant difference to the values of D_0(static) for small cribs under full and quarte ventilation. These fires were burning under air-rich conditions and while some flaming was observed outside the ventilation opening of the fire box on its own, none appeared from the end of the 1 m corridor. Combustion of the volatiles would seem to be largely complete within the fire compartment. While the burning behaviour of the medium cribs appears to be similar, that of the large cribs was quite different, apparently falling within the ventilation controlled (fuel-rich) regime.

Continued combustion in the gases flowing from the compartment followed by vigorous burning in the fire plume outside the test rig, introduces several other factors which are likely to affect the final smoke. Further experimental work is planned to study this scenario in more detail: at the present time, interpretation of these data must be at least partly speculative.

The data from the small and medium cribs show most clearly that D_0(dynamic) is considerably less than D_0(static). A possible explanation would be that the smoke flowing from the end of the corridor is hot and has not fully matured: condensation and coagulation processes will occur as the hot combustion products cool as they mix with ambient air, yielding a much higher concentration of suspended matter, liquid and solid. For example, water will still be in the vapour phase at the temperatures measured in the outflow (Table 4.26). It was to test this hypothesis that a 2 m extension to the 2 m corridor was prepared, to discover if additional cooling would result in a higher value of D_0 (dynamic). As can be seen in Figures 5.14 and 5.16, the results are inconclusive. If smoke temperature is the main factor in creating this discrepancy then it would seem that greater cooling will be necessary to produce a significant effect.

It is interesting that the values obtained for D_0(dynamic) are similar to D_0(EU). Rasbash and Pratt (1979/80) compared the dynamic smoke yields from fires in a full scale room-corridor assembly (Woolley *et al.*, 1979/80) with the yields predicted from small scale test results (i.e. D_0(EU)) and found reasonable agreement. However, in view of the results obtained in the present series of experiments, this would appear to be fortuitous.

The present result that D_0(dynamic) < D_0(static) (see Figure 5.14) is contrary to a report by Paul (1983) which indicated that for upholstered polyether foam cushions D_0(dynamic) is greater than D_0(static) by as much as a factor of 3. While the reason for this apparent discrepancy has not been resolved, it is worth noting some differences in the experiments, in addition to the material involved. The volume of the chamber used by Paul was 100 m^3, in which substantially greater quantities of smoke were being collected than in the present tests with a volume of 240 m^3. Secondly, Paul waited for 15-20 minutes after the fire had ceased before making his static measurements. An ageing process will certainly be operating and may be significantly more rapid at higher concentrations. However, the present results indicate that this would not account for more than a 25-30 per cent drop in D_0(static) over a similar period. Two other differences may be mentioned. In Paul's experiments, the combustion gases were discharged vertically from the rig through a duct, which would have resulted in their direct impingement on the ceiling, approximately 1 m above the outlet. In the present tests, the discharge was horizontal and the distance to the ceiling was approximately 2 m. Loss of smoke particles by deposition on the ceiling could have been significant in Paul's experiments which were carried out in a closed room-corridor assembly with a much higher surface to volume ratio than the firehouse at Gullane.

The comparative behaviour of PMMA and PP merits comment. Under free burning conditions, D_0(static) for PP is almost ten times greater than D_0(EU). This may be a consequence of the difficulties associated with testing a material which melts and flows so readily in the vertical orientation (PMMA softens but does not flow significantly), but equally, it may reflect a difference between horizontal and vertical burning.

However, D_0(static) for PMMA increases by a factor of three when it is burnt within the fire box with one-quarter ventilation, while the increase is only 15 per cent for PP (Figure 5.16). Further tests will be necessary to establish the cause of this but one factor that deserves consideration is flame emissivity. The flames from PMMA are less emissive than those from PP (Markstein, 1978) and consequently it may be more sensitive to radiative feedback within the firebox. (This observation implies a number of assumptions relating to smoke production as a function of rate of burning and the structure of the diffusion flame, as well as the role of ventilation in determining smoke yields if high rates of burning are involved). In contrast, the yield of smoke from the wood cribs burning in the fully ventilated fire box was not significantly different from that from free burning; this is consistent with the fact that the greater proportion of the burning surfaces of a wood crib are shielded from the radiative feedback from the compartment.

A more extensive analysis of the experimental data will be presented elsewhere.

Conclusions

The yield of cold smoke from fires in enclosures is likely to be significantly greater than that predicted on the basis of small scale laboratory tests. Dynamic measurements of hot smoke also underestimate the final yield.. Small scale experiments have shown the need for greater understanding of the effect of confinement on smoke production from different materials. Until this has been achieved, it will not be possible to incorporate realistic smoke production rates into smoke movement models, and the application of the results of small scale tests such as ASTM E662 to selection of materials will have to be treated with circumspection.